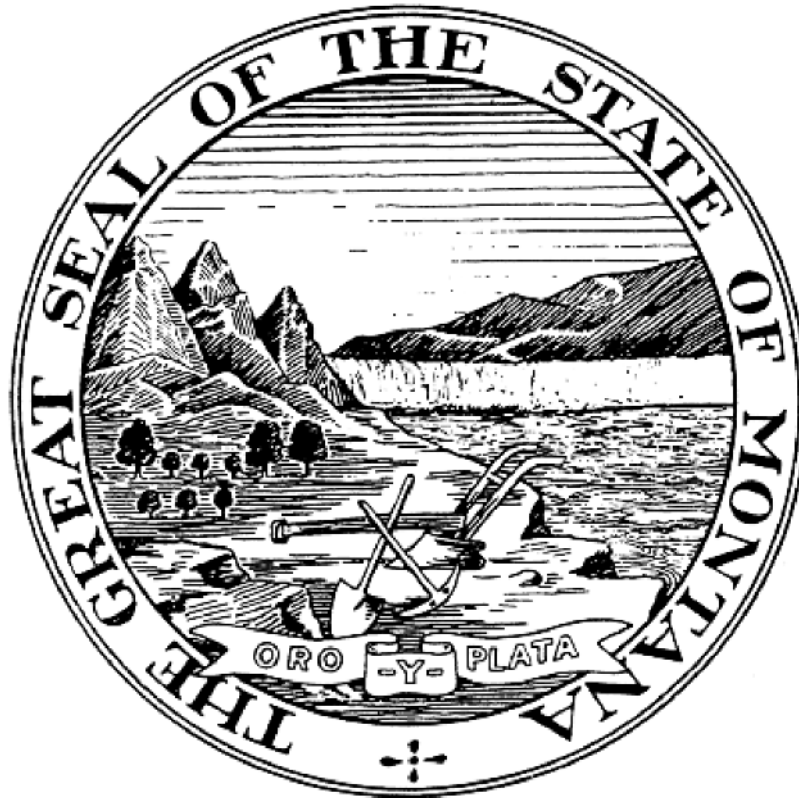


# STRUCTURES MANUAL



Volume I — Administration and Procedures



## PREFACE

The **Montana Structures Manual** has been developed to provide uniform structural design practices for Department and consultant personnel preparing contract plans for Department projects. The bridge designer should attempt to meet all criteria presented in the **Manual**. However, the **Manual** should not be considered a "standard" which must be met regardless of impacts.

The **Manual** presents much of the information normally required for a structural project; however, it is impossible to address every situation which the bridge designer will encounter. Therefore, designers must exercise good judgment on individual projects and, frequently, they must be innovative in their approach to structural design. This may require, for example, additional research into the structural design literature.

The **Montana Structures Manual** was developed by the MDT Bridge Design Section. The **Manual** Review Committee consisted of:

Bob Modrow (Project Coordinator)  
Bryan Miller  
Kevin McCray  
Dave Johnson  
Jeff Olsen  
Devin Roberts  
Nigel Mends

# **MONTANA STRUCTURES MANUAL**

## **(Revision Process)**

All revisions to the **Montana Structures Manual** will be submitted and reviewed according to the following process:

### **Revision and Review**

1. All proposed revisions should be submitted to the Bridge Design Engineer. The Revision Request Form (next page) should be used for the submittal.
2. A four-person Review Committee, selected by the Bridge Design Engineer, will meet every three months, or as necessary, to review the proposed changes.
3. The Committee will submit their recommendations and will meet with the Bridge Design Engineer to determine if the proposed revisions should be incorporated into the **Manual**.
4. If the revisions represent a policy change, the revisions will be presented to the District Administrators for comment.
5. If the **Manual** will be revised as recommended, a memo describing the revision will be distributed by the Bridge Design Engineer. The revised pages of the **Manual** will be attached to the memo and will be sent to all **Manual** holders.

### **Review Committee**

The Review Committee will consist of four members. One member will be replaced each year; therefore, no one will serve on the Committee for more than four consecutive years. Individuals may serve on the Committee more than once.

In addition to the review of proposed revisions, the Committee will be responsible for the following:

1. providing all updates for the **Structures Manual**,
2. maintaining a comprehensive list of all **Manual** holders, and
3. maintaining a library of all revisions to the **Manual** in chronological order.

# MONTANA STRUCTURES MANUAL (Revision Request)

## **Identification**

Date Submitted:

Section To Be Revised:

Section Title:

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Page Number(s):

## **Description of Revision**

List other sections of the Manual that would be affected by the revision:

- A.
- B.
- C.

List the **Bridge Standard Drawings** that would be affected by the revision:

- A.
- B.
- C.

## **Justification For The Revision**

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Chapter Sixteen	Prestressed Concrete Superstructures	Chapter Twenty-five	Computer Program
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## **Chapter One**

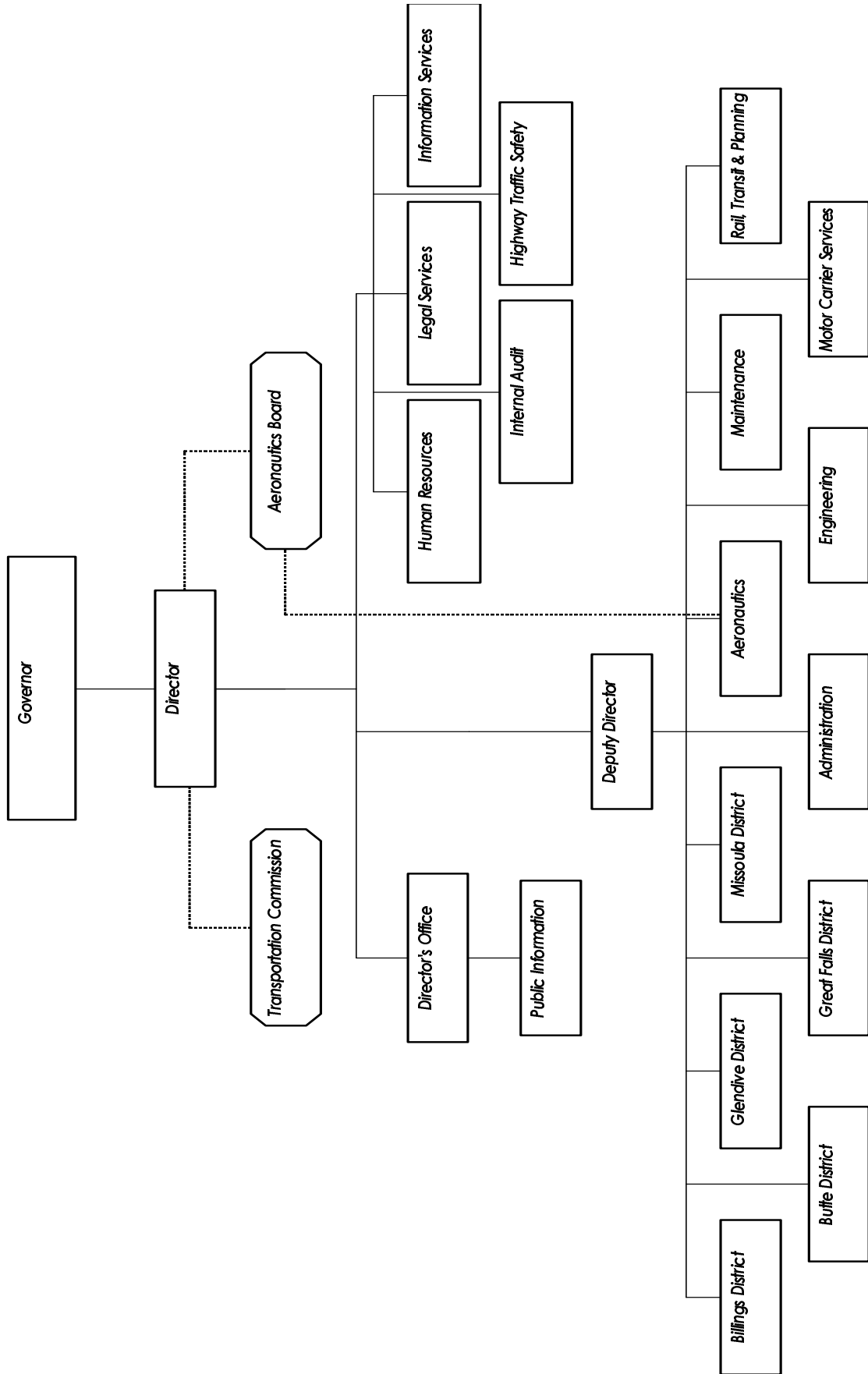
# **MDT ORGANIZATION**

Chapter One discusses the organization and functions of those units within the Montana Department of Transportation which consistently interact with the Bridge Bureau. The Chapter summarizes this information for:

1. selected units outside of the Engineering Division,
2. each Bureau within the Engineering Division,
3. each Section within the Preconstruction Bureau, and
4. each Section and Unit within the Bridge Bureau.

### **1.1 ORGANIZATIONAL CHART**

Figure 1.1A presents the organization of the Montana Department of Transportation as of April 2004.



Montana Department of Transportation  
April 2004

Figure 1.1A

## **1.2 COORDINATION WITH BRIDGE BUREAU**

The Bridge Bureau, in the administration of its responsibilities, must interact with many MDT units. The specific nature of the coordination is discussed elsewhere in the **Structures Manual** as follows:

1. Chapter Two describes the project development process.
2. Chapter Three describes the coordination between the Bridge Bureau and other units within the MDT.

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### 1.3 UNITS OUTSIDE ENGINEERING DIVISION

This Section briefly describes the organization and functions of those units not within the Engineering Division which may interact with the Bridge Bureau.

#### 1.3.1 Transportation Commission

The Transportation Commission is composed of members appointed by the Governor; the Commission reports to the Director of the Montana Department of Transportation. The duties and responsibilities of the Transportation Commission are delineated in the **Montana Code Annotated**. In consultation with other applicable entities, the functions of the Montana Transportation Commission include:

1. Project Prioritization (§60-2-110). The Commission establishes priorities for construction and reconstruction projects on the Montana State Highway system.
2. Contract Letting (§60-2-111). The Commission lets all contracts for the construction or reconstruction of those highways administered by the Department.
3. System Designation (§60-2-126). The Commission designates which public highways within the State are located on the:
  - a. national highway system
  - b. primary highway system,
  - c. secondary highway system, or
  - d. urban highway system.

*Note: The **Intermodal Surface Transportation Efficiency Act** of 1991 realigned the Federal-aid system and eliminated the Federal-aid primary, secondary and urban systems.*

4. Allocation of Funds (§60-2-127). The

Commission allocates the available Federal-aid funds for expenditure on the various highway systems.

5. Maintenance (§60-2-128). The Commission designates those public highways that are on the State highway maintenance system.

#### 1.3.2 District Offices

The Department maintains five District Offices based on geographic areas in the cities of Missoula, Butte, Great Falls, Glendive and Billings. The basic function of each District Office is to provide the necessary field services for the Department within their geographic boundaries. Some of the responsibilities include:

1. maintaining the State highway system (e.g., snow removal, pavement maintenance);
2. providing construction inspection for Department construction projects;
3. nominating projects for capital improvements and assisting in the identification of the Project Scope of Work;
4. inspecting bridges to gather NBIS data;
5. designing selected projects;
6. reviewing and approving requests for private access onto the State highway system;
7. serving as liaison between the local governments and Department Central Office;
8. performing field surveys;
9. performing soils surveys;
10. assisting with conducting public hearings and public information meetings;

11. reviewing and commenting on the proposed traffic control plan during construction and, in some cases, developing the traffic control plan for direct insertion into the final plan assembly;
  12. responding to public inquiries;
  13. assisting in the maintenance of the Department's Sign Inventory; and
  14. field utility agreements and Right-of-Way acquisition.
4. coordinating with the lead unit on project scoping;
  5. coordinating with the lead unit in the identification and evaluation of project alternatives;
  6. preparing or reviewing the environmental document;
  7. preparing Section 4(f) and Section 6(f) Statements;
  8. coordinating with the applicable State or Federal agency to secure the necessary project permits/approvals, including:
    - a. Section 404 permit,
    - b. Section 10 permit,
    - c. Section 401 certification,
    - d. Section 402 (NPDES) permit,
    - e. floodplains encroachment approval (FEMA) in coordination with the Hydraulics Unit),
    - f. farmland preservation impacts (NRCS),
    - g. Stream Preservation Act (SPA) permit, and
    - h. Tribal Employment Rights Office (TERO) agreement;

### **1.3.3 Environmental Bureau**

The basic function of the Environmental Bureau is to provide guidance for all units within the Department on all environmental issues. Environmental issues normally include Federal and State environmental laws, and the Office represents the Department on these laws with other agencies, States and private entities.

#### **1.3.3.1 Engineering Section**

The Engineering Section is directly involved with the lead unit in project development to ensure that the project complies with Federal and State environmental laws and regulations. The Section's responsibilities include:

- a) determining the application of the National Environmental Policy Act to all Department projects, including project environmental classification (i.e., categorical exclusion, environmental assessment or environmental impact statement);
  - A. determining the need for early coordination with other State and Federal agencies and initiating contacts;
3. identifying and contacting the cooperating agencies;
9. in coordination with the lead unit, developing a plan to mitigate environmental impacts;
10. reviewing and commenting on the plan for temporary erosion control during construction; and
11. determining Department compliance with the public involvement process.

### 1.3.3.2 Resources Section

The Resources Section is responsible for identifying all environmental resources within the proposed project limits and for evaluating the potential project impacts on these resources. The Bureau's responsibilities include:

1. conducting environmental surveys and inventories or supervising contractor's surveys and inventories;
2. evaluating potential project impacts on biological resources, including:
  - a. wetlands,
  - b. threatened and endangered species,
  - c. fish habitat, and
  - d. water quality;
- B. evaluating potential project impacts on cultural resources, including:
  - a. historical,
  - b. archaeological, and
  - c. socio-economic;
4. preparing or reviewing those portions of environmental documents which address biological and cultural resources;
5. coordinating with the applicable State or Federal agency to secure selected project permits/approvals, including:
  - a. Section 106 (SPHO) concurrence, and
  - b. Montana Department of Fish, Wildlife and Parks approvals;
6. coordinating with the Engineering Section in securing other permits and approvals (e.g., Section 401, SPA); and
7. coordinating with the Engineering Section in developing a plan to mitigate impacts on biological and cultural resources.

### 1.3.3.3 Hazardous Waste Section

The Hazardous Waste Section is responsible for identifying and evaluating various potential project impacts, including:

1. evaluating the potential project impacts on air quality (during and after construction) and determining the project's consistency with State and Federal laws on air quality;
2. evaluating the potential noise impacts (during and after construction) precipitated by the project and determining the project's consistency with State and Federal laws on noise impacts;
3. identifying hazardous waste sites and determining the needed mitigation measures;
4. reviewing the Comprehensive Environmental Response, Compensation and Liability Information System (CERCLIS) site listing for Montana; and
5. implementing the Montana clean-up program for underground storage tanks.

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## 1.4 ENGINEERING DIVISION

This Section discusses the function of each bureau within the Engineering Division, except the Bridge Bureau (see Section 1.5).

### 1.4.1 Preconstruction Bureau

#### 1.4.1.1 Road Design Section

The Road Design Section is responsible for all capital improvement projects for which the Section serves as the lead unit for project development. The Section has five Area Project Supervisors who are assigned to each of the five geographic Districts within the State. The functions of the Section include:

1. coordinating all activities necessary for the design of a roadway project (e.g., surveying, environmental evaluation, right-of-way, hydraulics, traffic engineering);
2. preparing the detailed roadway design plans, quantities, special provisions, etc., to advance the project to advertisement;
3. maintaining the Department's **Detailed Drawings** which document the details for roadway design elements;
4. providing technical assistance to local jurisdictions on road design issues;
5. providing road design support as needed on projects for which another Department unit is lead (e.g., roadway approaches for bridge replacement projects);
6. developing and promulgating Department policies and procedures on road design issues (e.g., sidewalk warrants, roadside barrier end treatments, geometric design policies); and
7. maintaining the Department's **Road Design Manual**.

#### 1.4.1.2 Consultant Design Bureau

The Consultant Design Bureau prepares requests for proposals, evaluates and rates proposals, and prepares and negotiates agreements, contracts and supplements for various consultant services. The Section administers, directs, monitors and reviews activities of consultant firms and individuals, and it coordinates consultant activities within the Department.

Consultant services include but are not limited to:

1. bridge design,
2. road design,
3. traffic engineering,
4. location surveys and ground control,
5. legal land surveys and monumentation,
6. hydraulics,
7. soils and pavements,
8. geotechnical,
9. materials,
10. utilities,
11. construction,
12. exploration, and
13. numerous environmental matters.

#### 1.4.1.3 Hydraulics Section

The Hydraulics Section is responsible for the hydrologic and hydraulic analyses for roadway drainage appurtenances and bridge waterway openings. The Section's responsibilities include:

1. developing and promulgating Department policies and procedures on hydraulics (e.g., hydrologic methods, bridge waterway openings, culvert hydraulics, design of closed drainage systems);

2. providing hydraulics input to the project lead units (e.g., Road Design Section, Bridge Bureau) as needed during project development;
  3. working with District Offices to respond to public inquiries on drainage problems;
  4. working with local jurisdictions and the Federal Emergency Management Administration (FEMA) on the administration of the National Flood Insurance Program (NFIP);
  5. working with the Environmental Services Office to secure those permits and approvals related to the State's waterways and water resources (e.g., U.S. Coast Guard Section 9, U.S. Corps of Engineers Section 404);
  6. determining field surveying needs for hydraulic analyses and working with the District Offices to secure the field information;
  7. designing irrigation systems (e.g., siphon details); and
  8. providing technical assistance on hydraulics as needed to other Department units and local jurisdictions.
2. maintaining the **Surveying Manual**;
  3. maintaining survey datums and coordinate systems for a reference or base for all surveys in the State;
  4. purchasing and maintaining surveying equipment needed Statewide by the Department;
  5. checking the District's control traverse survey data and plotting the control traverse diagram;
  6. maintaining the necessary records and filing system for all Department surveys;
  7. coordinating as necessary with the National Geodetic Survey; and
  8. providing technical assistance on surveying as needed to other Department units and local jurisdictions.

#### **1.4.1.4 Photogrammetry and Survey Section**

The Photogrammetry and Survey Section, in combination with the District field survey crews, is responsible for all surveying needs required for the Department's program of projects. The Section's responsibilities include:

1. developing and promulgating Department policies and practices for surveying activities on Department projects for both design and construction;

#### **1.4.2 Right-of-Way Bureau**

The Right-of-Way Bureau is responsible for the acquisition, management and control of real property needed for transportation purposes. Right-of-way operations are partially decentralized. The administrative organization and all functional sections are located in the Department's headquarters in Helena. Field right-of-way operations are performed by personnel working in the Right-of-Way Sections of the five District Offices. The functions performed by the Right-of-Way Bureau are described in the following sections.

##### **1.4.2.1 Appraisal Section**

The Appraisal Section is responsible for the valuation of interests in real property to be

acquired by the Department. It is responsible for:

1. developing appraisal policies, procedures and guidelines;
  2. providing technical education for the training and continuing development of staff appraisers;
  3. arranging services for outside fee appraisers when needed;
  4. providing technical assistance to staff and fee appraisers;
  5. reviewing all appraisals prepared for the Department; and
  6. determining the compensation that should be paid for each parcel of real property to be acquired.
2. conducting direct negotiations with utility and railroad companies, when necessary, to acquire portions of their operating rights-of-way for highway purposes; and
  3. developing policies and procedures governing the occupancy of highway right-of-way by public utility facilities.

#### **1.4.2.4 Design/Plans Section**

The Design/Plans Section is responsible for:

1. programming funds for right-of-way acquisition;
2. securing land title evidence for properties to be purchased by the Department;
3. securing right-of-way cost estimates and other information for route studies, program funding, environmental studies and justification of land service facilities;
4. preparing right-of-way plans and providing coordination among organizational units of the Right-of-Way Bureau, Preconstruction Bureau and the Federal Highway Administration on the preparation and approval of right-of-way and utility plans;
5. issuing authorizations for initiating the various phases of right-of-way acquisition work;
6. preparing property descriptions, plats and exhibits for use in property deeds and other documents and agreements used in the purchase or disposal of real property; and
7. obtaining information for and preparing access control plans and access control resolutions for Transportation Commission approval.

#### **1.4.2.2 Field Right-of-Way Sections**

There are three Field Right-of-Way Sections in the Central Office. These Sections are responsible for providing the field services as required for right-of-way acquisition and other functions performed by the Right-of-Way Bureau. This includes the appraisal of and negotiation for interests in real property needed by the Department and includes preparing preliminary studies and cost estimates.

#### **1.4.2.3 Utilities Section**

The Utilities Section is responsible for:

1. obtaining cost estimates for securing agreements with utility and railroad companies for the relocation and adjustment of their facilities as required for highway construction;

**1.4.2.5 Land Section**

The Land Section is responsible for:

1. managing property acquired for highway construction;
2. developing policies, procedures and guidelines for property management;
3. administering and maintaining records for the Outdoor Advertising Control and Junkyard Control Programs;
4. performing closing activities for right-of-way parcels;
5. maintaining the official files and records of the Right-of-Way Bureau;
6. auditing right-of-way settlements and other actions to ensure compliance with prescribed policies and procedures;
7. processing claims for payment of right-of-way settlements;
8. obtaining mortgage releases;
9. filing deeds and other recordable documents with other public offices;
10. processing reimbursement of tax payments;
11. preparing and maintaining parcels and project files;
12. arranging for microfilming of files, plans, maps, etc.;
13. maintaining statistical records; and
14. administering the Tourist Oriented Directional Signs (TODS) and the business logo sign (LOGO) programs.

**1.4.2.6 Negotiation Section**

The Negotiation Section is responsible for the acquisition phase of acquiring property for the Department. It is responsible for:

1. developing negotiation policies, procedures and guidelines;
2. providing education and training for staff negotiators;
3. reviewing and approving negotiated settlements of right-of-way parcels;
4. providing relocation assistance to displaced property owners; and
5. coordinating the processing of right-of-way parcels for condemnation.

In addition, the Negotiation Section provides liaison and coordination among other organizational units of the Right-of-Way Bureau, the Department and the Federal Highway Administration on right-of-way negotiations. It coordinates actions to resolve damage claims from landowners, and it oversees acquisition policies and activities of the Missoula and Billings Field Right-of-Way Sections in coordination with their District Administrators.

**1.4.3 Construction Bureaus**

The overall responsibilities of the Construction Bureaus include:

1. developing policies and procedures for contract administration and inspection;
2. maintaining the **Construction Manual**;
3. developing specifications for construction;

4. processing and approving subcontracts;
5. reviewing traffic control plans;
6. monitoring project inspection practices;
7. reviewing bridge false work and cofferdam drawings;
8. administering the contractor overtime law;
9. approving major change orders (above \$10,000);
10. purchasing and maintaining construction survey equipment;
11. investigating damage and defects in structural elements;
12. resolving contractor claims that reach impasse or litigation;
13. evaluating cost savings proposals;
14. approving final estimates; and
15. coordinating with other State agencies.

The following briefly discusses the sections within the Construction Bureau.

#### **1.4.3.1 Materials Bureau**

The Materials Bureau is responsible for ensuring the quality of all materials, through testing and certification, incorporated into the State highway system. The following summarizes the functions of the sections within the Bureau.

##### **Physical Testing Section**

The Physical Testing Section is responsible for the laboratory testing of all materials, either through providing guidance to the District labs

or performing the testing itself. All testing is based on the **AASHTO Standard Specifications for Transportation Materials and Methods of Sampling and Testing (Parts I & II)**, adapted for application in Montana. The Physical Testing Section is also responsible for conducting lab inspections and maintaining the **Materials Manual**.

##### **Geotechnical Section**

The Geotechnical Section is responsible for all subsurface investigations required for Department projects (e.g., for bridge foundations, earth slope stability, bearing capacities, rock cuts, muck excavation, erosion control, subdrainage). Where needed, the Section also prepares the design of retaining walls (in coordination with the Bridge Bureau), reinforced earth walls, bin walls and gabions.

##### **Materials Services Section**

The Materials Services Section is responsible for:

1. determining the pavement design for Department projects;
2. conducting non-destructive testing on existing pavements to determine, for example, the bearing capacity of the existing pavement structure;
3. providing quality control and certification for materials used in Department projects; and determining the need for any new materials and/or experimental items in the project and developing the specifications and special provisions for the items.

#### **1.4.4.2 Contract Plans Bureau**

The Contract Plans Bureau develops the PS&E (plans, specifications and estimate) for highway project lettings to contract. Specific responsibilities of the Bureau include:

1. preparing the work sheets to properly identify the Department and FHWA codes, funding splits, etc., for all contract items;
2. reviewing the project plans to ensure that they meet Department and FHWA requirements and that they are suitable for bidding;
3. preparing the Proposal for each contract identifying the location, scope and requirements of the contract;
4. reviewing and editing the Special Provisions as necessary for any work, material or method of operation;
5. preparing the Engineer's Estimate;
6. preparing any necessary City/Town Agreements and/or County Resolutions; and
7. performing all necessary administrative work for bid letting.

#### **1.4.4.3 Construction Engineering Services Bureau**

The Construction Engineering Services Bureau monitors construction inspection and contract administration of construction projects through field inspections. The Section reviews plans and specifications for compatibility with construction practices and consults with and advises District construction engineers and project managers on construction problems.

#### **1.4.4.4 Contractor Estimate Section**

The Contractor Estimate Section processes all contract estimates — both progress and final — for submission to Accounting for payment, including reviewing the final estimates and supporting documentation and submitting the necessary documentation to FHWA to close out completed projects.

#### **1.4.4.5 Change Order and Utilities Section**

The Change Order and Utilities Section processes change orders and utility work orders. The Section:

1. maintains files on utility agreements,
2. reviews and processes non-structural-related shop drawings,
3. prepares specifications for the purchase of surveying equipment,
4. arranges for surveying equipment repairs,
5. maintains an inventory of equipment, and
6. supervises the monthly rental of Electronic Distance Measuring (EDM) equipment.

#### **1.4.4.6 Specifications Section**

The Specifications Section reviews and develops new and revised specifications; processes Supplemental Specifications and obtains FHWA approvals; and periodically updates and publishes new editions of the Department's **Standard Specifications for Road and Bridge Construction**.

### 1.4.5 Traffic and Safety Bureau

#### 1.4.5.1 Traffic Engineering Section

The Traffic Engineering Section is responsible for all capital improvement projects for which the Section serves as the lead unit, and the Section provides a variety of traffic engineering services to other Department units. The functions of the Section include:

1. all signing and pavement marking practices and designs on Department projects;
2. all traffic signal and highway lighting practices and designs on Department projects;
3. the geometric design for interchanges and at-grade intersections;
4. highway capacity analyses;
5. the detailed design of highway safety improvement projects;
6. traffic engineering studies (e.g., speed studies, traffic impact studies, school crossing studies);
7. coordinating all activities necessary for the design of a traffic engineering project;
8. maintaining the Department's **Detailed Drawings** which document the details for traffic engineering elements;
9. providing technical assistance to local jurisdictions on traffic engineering issues;
10. providing traffic engineering support as needed on projects for which another Department unit is lead; and
11. maintaining the Department's **Traffic Engineering Manual**.

#### 1.4.5.2 Safety Engineering Section

The Safety Engineering Section is responsible for three major Department functions:

1. Safety Improvement Program. The Safety Engineering Section is responsible for identifying and programming all projects which will use the categorical and set-aside funds for highway safety improvements. The Program procedures include a benefit/cost analysis to determine if the proposed improvement is cost effective, and it is used to prioritize safety improvement projects to optimize the safety benefits from the available funds.
2. Accident Surveillance System. The Safety Engineering Section is responsible for reviewing the accident history on projects through the use of its Accident Surveillance System. The review will identify correlations between accident characteristics compared to Statewide trends and any accident cluster areas. The Section makes recommendations for safety enhancements based on the accident analysis. In addition, the Safety Engineering Section provides accident data to other entities which may request the information (e.g., local jurisdictions).
3. Safety Management System. The Safety Management System is a multi-disciplinary team approach to traffic safety. Its goal is to reduce the number and severity of traffic accidents.

#### 1.4.5.3 Railroad Safety Section

*To Be Prepared*

#### **1.4.5.4 Occupant Protection Section**

*To Be Prepared*

#### **1.4.6 Engineering Management Unit**

The Engineering Management Unit maintains and operates several management systems for Department operations. These systems generate a large variety of reports, containing information on projects in both preconstruction and construction phases:

1. Preconstruction Management System (PMS). The basic objective of the PMS is to schedule, monitor and coordinate project development and manpower needs within the multiple-project environment of preconstruction. The PMS is a mainframe system which is augmented by several Oracle-based systems. These systems interface with other Departmental systems and provide data pertinent to projects in the preconstruction phases.
2. Construction Management System (CMS). The CMS is designed to plan and schedule the Department's construction engineering manpower to effectively fulfill Department responsibilities for its program of construction projects. The CMS is a PC-based system which interfaces with other Departmental systems and provides data pertinent to projects in the construction phase.

#### **1.4.7 CADD Unit**

The CADD Unit is responsible for managing the Department's use of its computer-aided drafting and design package, which is MicroStation. This includes:

1. developing uniform conventions for the use of CADD,

2. maintaining the Statewide CADD network,
3. providing technical support to all CADD users,
4. upgrading the CADD package as necessary,
5. maintaining the **MDT CADD Users Guide** and the **MDT GEOPAK Users Manual**, and
6. providing project visualization services.



## 1.5 BRIDGE BUREAU

The Bridge Bureau is responsible for the design and operation of the bridges and other structures on Montana's highway system, and the Bureau provides input into the construction and maintenance of these structures. This applies fully to the State-maintained system and, to a lesser extent, the locally maintained system.

The Bridge Bureau prepares all necessary structural design plan sheets and submits these to the Contract Plans Section for direct insertion into the final plan assembly.

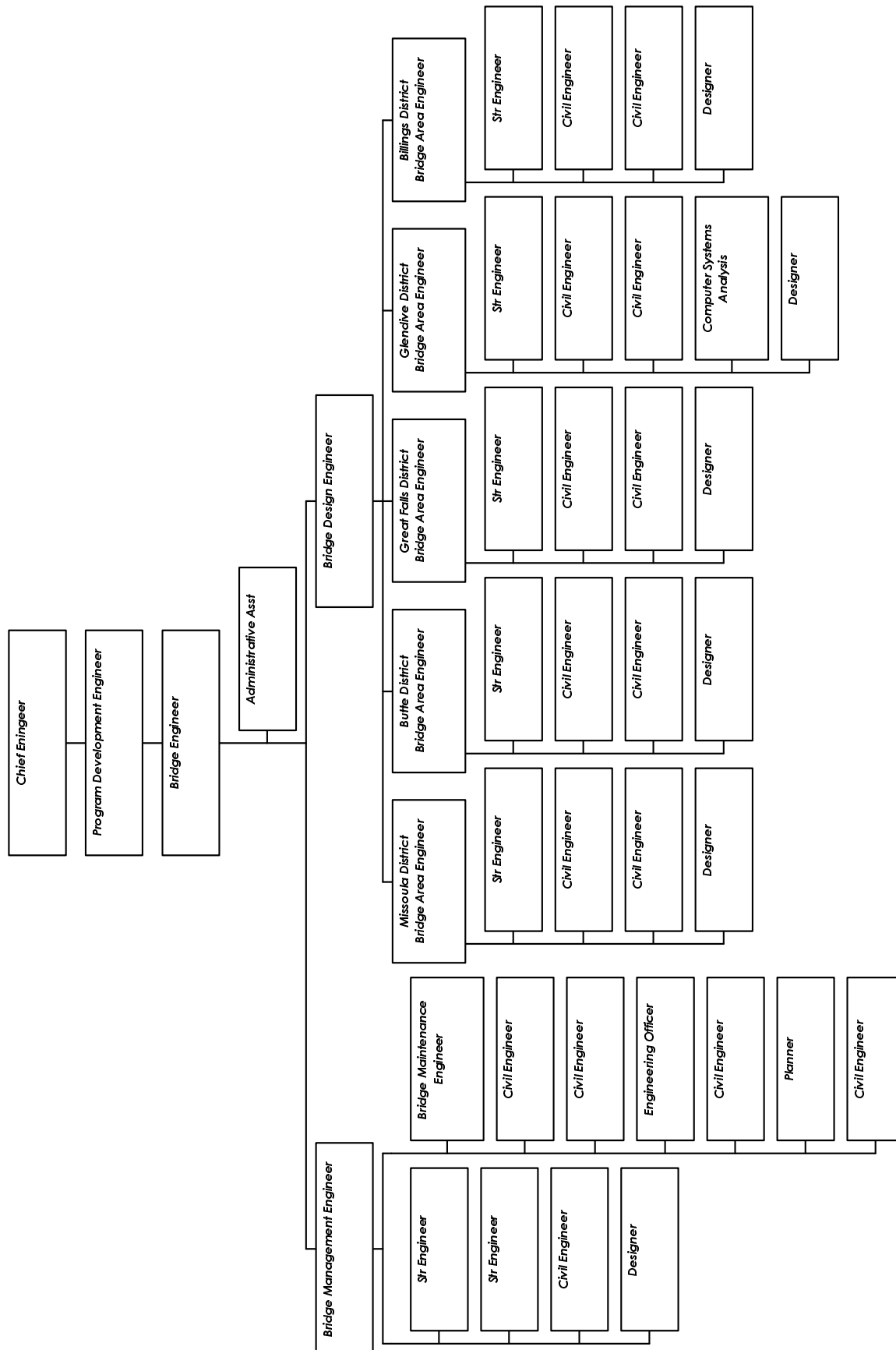
Figure 1.5A presents the organizational structure of the Bridge Bureau. The chart presents the functional units within the Bureau; it is not a personnel organizational chart. The following sections discuss the specific responsibilities of each functional unit in Figure 1.5A.

### 1.5.1 Bureau Administration/Management

#### 1.5.1.1 Bridge Engineer

The Bridge Engineer is responsible for the overall administrative/management activities of the Bridge Bureau. The Bridge Engineer establishes overall Department structural policies and determines the Bureau's coordination with units outside of the Bridge Bureau. The functional responsibilities of the Bridge Engineer are to:

1. develop work programs for bridge projects for inclusion in the Department's annual, 3-year and 10-year programs of projects;
2. participate in professional organizations related to bridge design (AASHTO, TRB, AWS) to represent the Department's interests and concerns;
3. initiate and oversee the development of:
  - a. new and revised standard sheets for structural designs in the Department's **Bridge Standard Drawings**,
  - b. revisions to the Department's **Structures Manual**,
  - c. structural specifications (in a participation role) for the Department's **Standard Specifications for Road and Bridge Construction**;
  - d. the structural design criteria used by the Bureau; and
  - e. geometric design criteria used for the design of bridges (e.g., bridge widths, vertical clearances, bridge rails, sidewalk warrants);
4. represent the Department in all litigation related to structural issues;
5. determine the Bridge Bureau's appropriate participation in public hearings and public informational meetings for projects where the Bridge Bureau is the lead unit;
6. for projects with structural items, review contract bids (when requested by the Contract Plans Section) for unbalanced bid items, bid estimates over engineer's estimate, etc.;
7. remain abreast of the key issues on individual bridge projects;
8. determine the Bridge Bureau's course of action for any special studies, reports, etc., upon request from the Director's office, FHWA, etc;



MDT BRIDGE BUREAU  
Figure 1.5A

9. serve as the Bureau's focal point for coordination with FHWA, MDT's Director's office, other MDT units, etc.;
10. provide final approval to all structural designs;
11. initiate and participate in the consultant selection process; and
12. manages the bridge adoption process.

#### **1.5.1.2 Administrative Assistant**

The Administrative Assistant is available to all personnel within the Bridge Bureau to perform a variety of administrative, clerical and technical support functions. The Administrative Assistant:

1. directly assists the Bridge Engineer in the:
  - a. development of budgets,
  - b. management of Bureau personnel,
  - c. administration of payroll activities,
  - d. scheduling of meetings, and
  - e. arranging travel for all Bureau personnel;
2. maintains a variety of Bureau files, including project files, personnel files, correspondence files, quantity files, and the structural design library;
3. prepares and processes purchase orders and vouchers payable (e.g., for office and engineering supplies, for travel);
4. provides typing services, when needed;
5. processes all incoming and outgoing mail;
6. performs miscellaneous errands as needed;
7. maintains office supply inventory; and

8. serves as a receptionist for the Bureau.

### **1.5.2 Bridge Design Section**

#### **1.5.2.1 Bridge Design Engineer**

The Bridge Design Engineer assists and advises the Bridge Engineer on those issues within the Bridge Design Section's responsibilities. The Bridge Design Engineer:

1. supervises and provides technical assistance to the five Bridge Design Units;
2. ensures that work is implemented according to Bureau policy and that it complies with the appropriate design standards and criteria;
3. ensures that the project design and construction plans are completed on schedule;
4. reviews plans, special provisions and estimates;
5. represents the Bridge Engineer at meetings and other functions;
6. signs payroll, personnel documents, correspondence, etc., in the Bridge Engineer's absence; and
7. revises and maintains standard drawings and the **Montana Structures Manual**.

#### **1.5.2.2 Bridge Design Units**

The Bridge Design Units are the Bureau's focal point for the preparation of all in-house structural designs. The Bridge Design Section has five Bridge Design Units which are assigned to specific geographic regions within the State. The Units have the day-to-day responsibility to develop structural plans from project inception

to PS&E advertisement. The specific functional responsibilities of the Bridge Design Unit design teams are to:

1. prepare in-house structural designs for all types of highway bridges (i.e., more than 6 m in length), including:
  - a. the determination of applicable loads to the bridge;
  - b. the design of reinforced concrete superstructures (structural analysis, reinforcement, shear, etc.);
  - c. the design of prestressed concrete superstructures (structural analysis, flexural strength, shear, bearings, etc.);
  - d. the design of structural steel superstructures (structural analysis, splices, diaphragms, fasteners, girder design, etc.);
  - e. in coordination with the Geotechnical Section, the design of substructures and foundations (piers, bents, piles, footings, abutments, etc.);
  - f. in coordination with the Road Design Section, the geometric design of the structure (e.g., bridge widths, vertical clearances);
  - g. the design of bridge accessories (bridge rails, sidewalks, curbs, fencing, lighting, signing);
  - h. the rehabilitation of existing bridges (e.g., condition surveys, bridge deck rehabilitation, superstructure rehabilitation); and
  - i. coordination with other Department units (environment, right-of-way, roadway design) as necessary for project development;
- j. draw required drawings and assign the project drawing numbers.
2. check in-house designs for bridges and other structures, including culverts, retaining walls (in coordination with the Geotechnical Section), sound barriers and, sometimes, supports for roadside appurtenances (e.g., signs, luminaires). Final plans are also checked by the design teams. Plans checking consists of the following:
  - a. a review of the correspondence file,
  - b. compliance with the **AASHTO Bridge Design Specifications** and **MDT Structures Manual**,
  - c. a comparison of the General Layout to the project constraints,
  - d. a check of cores, collar elevations and contour maps,
  - e. a check of the erection plans, footing plans, notes, quantities, etc.,
  - f. a check for dimensional errors,
  - g. an evaluation of constructability,
3. manage project development on those projects where the Bridge Bureau is the lead unit, including:
  - a. arranging and attending field reviews,
  - b. arranging and attending project meetings (e.g., Design Parameters Meeting),
  - c. preparing all project reports (e.g., Scope of Work Report),
  - d. meeting the project schedule and man-hour estimates,

- 
- e. coordinating with other units (internal and external to MDT) for all activities necessary for project design (e.g., environmental evaluation, right-of-way, hydraulics, roadway design), and
  - f. complying with the requirements of the Preconstruction Management System;
- 4. assist in the preparation of all necessary PS&E elements for structural items, including construction plans, special provisions, construction quantities and engineering cost estimates;
  - 5. prepare man-hour and cost estimates for in-house and consultant designs;
  - 6. in coordination with the Consultant Design Section, review structural designs prepared by consultants;
  - 7. review computer programs for structural applications and evaluate new programs for potential Department application;
  - 8. remain abreast of the state-of-the-technology in bridge design through review of AASHTO, TRB, FHWA, etc., publications, and investigate the use of new bridge design techniques;
  - 9. as directed by the Bridge Engineer, investigate and implement revisions to the:
    - a. **MDT Structures Manual,**
    - b. **MDT Bridge Standard Drawings,** and
    - c. **MDT Standard Specifications for Road and Bridge Construction;**
  - 10. provide technical support for structural designs for projects on non-State facilities which are funded by State and/or Federal dollars;
- 11. serve as a technical resource in structural designs for county and city government projects; and
  - 12. participate as needed in the field construction of structural elements, including:
    - a. in coordination with the Shop Drawings/NDT Unit, reviewing and approving construction shop drawings, erection drawings and false work drawings;
    - b. performing periodic field construction inspections; and
    - c. reviewing and commenting on construction change orders when requested by the Change Order and Utilities Section.

### 1.5.2.3 Quality Assurance Process

In an effort to assure quality of the PS&E documents, bridge documents are submitted to the Bridge Design Engineer for a QA Review. The Bridge Design Engineer or other professional engineer as assigned can do this review. If the Bridge Design Engineer chooses to delegate this responsibility to an Area Engineer, the Area Engineer can choose to delegate the QA Review to the Structural Engineer directly supervised by the Area Engineer. A PE must do QA Reviews. The QA Review is primarily to assure constructability and bidability of the bridge plans

This Review entails:

1. a review to assure all views and sections needed for construction are included;
2. see that the appropriate special provisions and notes are covered; and
3. that all needed pay items and quantities are covered on the Title Sheet and Bridge Plan Quantity Table.

### 1.5.2.4 Technical Experts

Each Design Unit will be responsible for at least one area of technical expertise. The technical expert will typically be the Structural Design Engineer for the Unit. Duties will typically include staying current with the AASHTO code requirements for the subject, and ongoing research and the latest technical information for the subject matter. The technical expert will typically be the contact for issues relating to their field of expertise. When code requirements change that affect typical Bureau Operation that expert will be required to inform the Bridge Design Engineer. Once a design policy is established, the Bridge Design Engineer will inform the Bureau by written memorandum to establish uniform Bureau Policy. If additional

information is needed the expert may be required to present a training session to the Bureau

The Bridge Bureau maintains a group of technical committees to assist other designers and establish bridge design policy for the Department. A list of these committees and members is located on the Internet at [http://mdtinfo.mdt.state.mt.us/bridge/net/external/bureau\\_experts/bureau\\_experts.pdf](http://mdtinfo.mdt.state.mt.us/bridge/net/external/bureau_experts/bureau_experts.pdf)

## 1.5.3 Bridge Management Section

The Bridge Management Section is responsible for a variety of services, including the operational programs administered by the Department for the State's bridges. The following sections briefly discuss the functional responsibilities of the units within the Bridge Management Section.

### 1.5.3.1 Bridge Management Engineer

The Bridge Management Engineer assists and advises the Bridge Engineer on issues concerning the daily ongoing operations of the State's bridges. The Bridge Management Engineer:

1. supervises and provides technical assistance to the three subordinate units and the Bridge Maintenance Engineer;
2. oversees the Bridge Management System (PONTIS);
3. works with Motor Carrier Services for permitting of overweight vehicles;
4. manages the seismic screening program for existing bridges; and

5. supervises the review and approval of shop drawings and NDT services during and after construction.

the load-carrying capacity of all bridges under the jurisdiction of the Department; and

### 1.5.3.2 Bridge Management Unit

The Bridge Management Unit is responsible for a variety of operational functions, including:

1. National Bridge Inspection Standards (NBIS). The NBIS Program, mandated by FHWA, is a systematic program of periodic bridge inspections intended to detect structural problems to minimize the probability of a catastrophic structural failure. The Bridge Management Unit manages the Statewide Bridge Inspection Program for both State and county/city bridges, including:
  - a. as required by the National Bridge Inspection Standards, coordinating the inspection of all bridges open to the public in Montana;
  - b. providing guidance to the District bridge inspectors;
  - c. managing and using the collected data;
  - d. developing and maintaining a written guide for the inspectors and providing training;
  - e. preparing and processing Structural Inventory and Appraisal (SI&A) data for all public bridges in the State;
  - f. maintaining an inventory on the structural and functional condition of all public bridges in Montana;
  - g. in coordination with the Districts, determining and posting (where needed)

- h. for locally owned bridges, recommending to the local government the posting of the load-carrying capacity of public bridges.

### 2. Bridge Management System (PONTIS).

PONTIS is a network-level Bridge Management System which incorporates dynamic, probabilistic models and a detailed bridge database to predict maintenance and improvement needs, recommend optimal policies, and schedule projects within budget and policy constraints. Through PONTIS, the Bridge Management Unit prioritizes the replacement, rehabilitation and maintenance of the State's bridges. It also assists in the prioritization of Federally funded bridge replacement/rehabilitation projects on local facilities. The overall objective of PONTIS is to systematically identify that combination of bridge improvement and maintenance work which optimizes the benefits from the Department's expenditures on bridges. The Bridge Management Unit is responsible for developing, implementing and maintaining PONTIS, including:

- a. developing a program of bridge improvements based on the findings from the MDT Bridge Inspection Program;
- b. incorporating cost-effective considerations into project prioritization;
- c. developing a prioritized list of Highway Bridge Replacement and Rehabilitation Program (HBRRP) projects and identifying preliminary project scopes of work (i.e., the extent of bridge rehabilitation);

- d. developing a prioritized list of bridge maintenance activities to be performed by the Districts;
  - e. tracking completion of recommended bridge maintenance work; and
  - f. for HBRRP projects, monitoring project implementation.
3. Overweight Trucks. In coordination with Motor Carrier Services, the Bridge Management Unit reviews, evaluates and approves/ rejects any requests for permits to exceed the legal load over structures.
4. Structural Failures. The Bridge Management Unit inspects and reports on all significant structural failures under the Department's jurisdiction.

#### **1.5.3.3 Seismic Unit**

MDT has developed a program to evaluate the existing bridges and proposed new bridges on the State highway system to ensure that they meet the AASHTO criteria for seismic design. Based on MDT warrants, the Seismic Unit reviews existing bridges for seismic vulnerability and designs the appropriate seismic retrofit on a priority basis. The Unit also supports the Bridge Design Section in the seismic design and analysis of new and rehabilitated bridges. In this capacity, the Seismic Unit performs a significant amount of preliminary design work for bridges within the context of addressing seismic vulnerability.

#### **1.5.3.4 Shop Drawings/NDT Unit**

In coordination with the Construction Bureau, the Shop Drawings/NDT Unit checks the shop drawings provided by the construction contractor for all structural elements (precast prestressed concrete beams, structural steel, erection, overhead signs, etc.). The Unit also certifies the welding for fabrication of structural steel and performs specialized bridge and sign inspections. The Unit, through its non-destructive testing function, also assists the Bridge Design Section in bridge rehabilitation projects.

#### **1.5.3.5 Bridge Maintenance Engineer**

The Bridge Maintenance Engineer serves a support function for the maintenance of bridges throughout the State. The responsibilities include:

- 1. upon request, providing technical assistance to the District Offices on bridge maintenance;
- 2. where necessary, coordinating with the Bridge Design Section on remedial action for relatively complicated bridge maintenance work;
- 3. administering force account work by Department forces for bridge maintenance;
- 4. from a quality assurance perspective, reviewing bridge maintenance plans; and
- 5. upon request, providing technical assistance to local governments on bridge maintenance.



## Chapter Two

# BRIDGE PROJECT DEVELOPMENT PROCESS

This chapter provides a schematic overview of the flow of a bridge project from inception to transmittal to Contract Plans. It also provides descriptions of each of the project activities specific to bridges.

The activities each represent elements from the Department's Critical Path Method (CPM) network for bridge projects. The Department uses the CPM network to manage the flow of projects through the design process. Each activity's description defines the tasks the activity requires, lists the end result of the activity, and describes which positions in the Department bear responsibility for seeing the activity completed successfully. The description also details the activities that must see completion before the current activity can begin and the activities that depend on the current one before they can start.

The schematic diagram presents a simplified form of the bridge CPM network. Its layout provides a sense of flow from the project's beginning, at the left edge of the diagram, to the transmittal of the project to Contract Plans, at the right, which represents completion of the project's design. The activities appear in columns representing work that should occur at roughly the same time. The columns do not represent rigid requirements. Activities from one column often overlap those from another. Note that each project has three phases: survey, design, and right-of-way. The diagram shows where the boundaries of the phases fall in relation to the activities.

The activities appearing in the diagram represent those that the "typical" project most commonly involves. However, not all

of these activities will appear in every project and some projects will add others that do not appear here. This diagram serves as a general guide for a project's flow and to help a project manager supervise a project by seeing which activities the project manager may need to initiate to keep the project design process moving smoothly.



PROJECT ACTIVITY	
<u>Activity Title:</u>	Preliminary Field Review
<u>Activity No.:</u>	550
<u>Responsible Unit:</u>	Bridge Bureau
<u>Activity Description:</u>	
DEFINITION:	Request, gather and develop information to define the project type, scope, and the process to be used for the project's development.
OUTPUT PROVIDED:	Preliminary Field Review Report outlining conceptual scope of project and potential environmental impact of the proposed project.
TASKS:	<p>The Preliminary Field Review is held in company with the District Administrator, District Engineering Services Supervisor, Right-of-Way Bureau, and others as deemed necessary. The Preliminary Field Review should cover the following:</p> <ol style="list-style-type: none"> <li>The alternate locations to be studied, project limits, major design features and R/W and utility involvement.</li> <li>The project design standards and opportunity for utilizing rehabilitation rather than a new structure.</li> <li>The potential environmental impacts of alternates and a preliminary determination about the level of environmental document required.</li> <li>The extent of field survey or mapping is determined at this time.</li> </ol> <p>The Preliminary Field Review Report documents the decisions made at the field review and requests FHWA or in-house approvals.</p> <p>Requests the District Administrator to obtain right of entry permission from landowners abutting proposed highway construction project and to proceed with the field survey and/or requests aerial mapping from the supervisor of the Survey and Mapping Section.</p> <p>Furnishes the Right-of-Way Bureau with a copy of the Preliminary Field Review Report and requests status of Right-of-Way and utilities as well as:</p> <ol style="list-style-type: none"> <li>Major utility or railroad problems that would affect the location.</li> </ol>

PROJECT ACTIVITY	
<u>Activity Title:</u>	Preliminary Field Review
<u>Activity No.:</u>	550 (Continued)
<u>Responsible Unit:</u>	Bridge Bureau
<u>Activity Description:</u>	
TASKS: (Continued)	<p>Furnishes the Transportation Planning Division a copy of the Preliminary Field Review Report showing the approximate location.</p> <p>Furnishes the Materials Bureau a copy of the Preliminary Field Review Report showing the approximate location being considered.</p> <p>Furnishes the Hydraulics Section a copy of the Preliminary Field Review Report showing the approximate location and requests a report on hydraulics.</p> <p>Furnishes the Traffic Bureau a copy of the Preliminary Field Review Report showing the approximate location for determination of traffic related problems.</p> <p>Requests information from any other source that will aid in the development of the project.</p> <p>Prepares cost estimates for the alternates being considered.</p>
START DEPENDENCIES:	Approved Program or project request from the Transportation Planning Division.
DISTRIBUTION AND USE:	<p>The Preliminary Field Review Report has a wide in-house and FHWA distribution and is used as an approval process to define the project general scope and intent.</p> <p>It is also used as a tool to gather information from those agencies and units listed under the tasks which will be used to develop the environmental report.</p>

PROJECT ACTIVITY	
<u>Activity Title:</u>	Draft and Transmit New Release
<u>Activity No.:</u>	552
<u>Responsible Unit:</u>	Bridge Bureau
<u>Activity Description:</u>	
DEFINITION:	The News Release outlines the general project scope, alerts various entities a project is being initiated and starts the information gathering process to determine which concerns and impacts must be considered. On projects where significant outside input is anticipated, a Letter of Intent is more appropriate than a New Release.
OUTPUT PROVIDED:	Draft News Release or Letter of Intent.
TASKS:	<p>Furnishes the Planning and Research Bureau two strip map prints and requests traffic data.</p> <p>Gather, review and develop information to determine general project parameters.</p> <p>Draft News Release or Letter of Intent.</p> <p>Distribute News Release or Letter of Intent.</p>
START DEPENDENCIES:	Preliminary Field Review Report.
DISTRIBUTION AND USE:	Distributes a draft news release to the Public Affairs Bureau with copies to the Chief Engineer, the Preconstruction Engineer, the District Administrator, and the Chief of the Environmental Services Bureau.

PROJECT ACTIVITY	
<u>Activity Title:</u>	Prepare for Public Hearing
<u>Activity No.:</u>	556
<u>Responsible Unit:</u>	Bridge Bureau
<u>Activity Description:</u>	
DEFINITION:	Develop and assemble information required to present the project at a Public Hearing.
OUTPUT PROVIDED:	Request for Public Hearing.
TASKS:	Prepares displays for the public hearing. Prepares cost estimates for the alternates being considered.  Requests the Public Information Bureau to set up a public hearing.
START DEPENDENCIES:	Aerial Photography.
DISTRIBUTION AND USE:	Distribute to the public at the Public Hearing.

PROJECT ACTIVITY	
<u>Activity Title:</u>	Bridge Model Analysis.
<u>Activity No.:</u>	560
<u>Responsible Unit:</u>	Bridge Bureau
<u>Activity Description:</u>	
DEFINITION:	Prepare necessary structural models to analyze load paths, load distribution and determine design loads. Includes superstructure, seismic, substructures and bridge system models.
OUTPUT PROVIDED:	Design loads for superstructure, substructure and foundation design. Submit foundation design forces to the Geotechnical Section. Description of load path for all major loads.
TASKS:	Determine vertical and lateral loads applied to the bridge.  Determine load paths for vertical and lateral loads.  Identify earthquake resisting system.  Review stiffness and resistance of proposed load path for efficiency.  Summarize design loads and load path.  Independent check of analysis.
START DEPENDENCIES:	Activity 572 – Bridge Plan-in-Hand Inspection.
DISTRIBUTION AND USE:	Memorandum to the Geotechnical Section with structure loads and requesting Geotechnical Engineering Design be performed for the structure.
COMPLETED WHEN:	Memorandum is sent to the Geotechnical Section.

PROJECT ACTIVITY	
<u>Activity Title:</u>	Distribute Survey Information and Request Design Input.
<u>Activity No.:</u>	562
<u>Responsible Unit:</u>	Bridge Bureau
<u>Activity Description:</u>	
DEFINITION:	Assembling of basic design data required to initiate design.
OUTPUT PROVIDED:	The basic information required for design.
TASKS:	Crew Chief assigns project to Engineer and reviews survey data for adequacy.
START DEPENDENCIES:	Survey and photo mapping.
DISTRIBUTION AND USE:	This basic design information is incorporated into preliminary plan development.



PROJECT ACTIVITY	
<u>Activity Title:</u>	Prepare Scope of Work Concept Report.
<u>Activity No.:</u>	566
<u>Responsible Unit:</u>	Bridge Bureau
<u>Activity Description:</u>	
DEFINITION:	Prepare Scope of Work Report.
OUTPUT PROVIDED:	Scope of Work Report defining scope of work, design criteria to be used, and any special features. This is used for preliminary project development.
TASKS:	<p>The Crew Chief prepares the scope of work report based on the design mapping, survey data, preliminary geotechnical information, typical section, environmental document, preliminary right-of-way and utility report, preliminary traffic study, and location hydraulic study report. The scope of work report will provide a detailed discussion of the following:</p> <ul style="list-style-type: none"> <li>a. Traffic characteristics</li> <li>b. Design speed</li> <li>c. Horizontal alignment</li> <li>d. Vertical alignment</li> <li>e. Staked and projected centerline characteristics</li> <li>f. Typical section characteristics</li> <li>g. Location and description of special features</li> <li>h. Impact on existing utility services</li> <li>i. Right-of-way acquisition needs</li> <li>j. Summary of geotechnical recommendations</li> <li>k. Major hydraulic considerations</li> <li>l. Mitigation measures committed to in the environmental document</li> <li>m. Proposed lighting, signal, school crossing, and railroad crossing treatment</li> <li>n. Construction traffic control measures</li> </ul> <p>Crew Chief transmits the scope of work report to the Bridge Engineer.</p> <p>Bridge Engineer distributes report and requests approval and/or comments from the following:</p> <ul style="list-style-type: none"> <li>a. Engineering Division Bureau Chiefs</li> </ul>

PROJECT ACTIVITY	
<u>Activity Title:</u>	Prepare Scope of Work Concept Report.
<u>Activity No.:</u>	566 (Continued)
<u>Responsible Unit:</u>	Bridge Bureau
<u>Activity Description:</u>	
TASKS: (Continued)	
	<ul style="list-style-type: none"><li>b. District Administrator</li><li>c. Administrators of the Maintenance and Program Development Divisions</li></ul>
	Bridge Engineer coordinates and acts on any comments received. Submits to Chief Engineer for his approval. Redistributes final scope of work report to all concerned. Requests concurrence of FHWA on all interstate projects.
START	
DEPENDENCIES: Approved environmental document.	
DISTRIBUTION	
AND USE:	Recommendations are incorporated into preliminary design development.
	Scope of Work Report is distributed to:
	<ul style="list-style-type: none"><li>a. Engineering Division Bureau Chiefs</li><li>b. District Administrator</li><li>c. Administrators of the Maintenance and Program Development Division</li><li>d. Other parties affected by project</li></ul>

PROJECT ACTIVITY	
<u>Activity Title:</u>	Prepare preliminary bridge layout and order cores.
<u>Activity No.:</u>	568
<u>Responsible Unit:</u>	Bridge Bureau
<u>Activity Description:</u>	
DEFINITION:	Preparation of preliminary bridge layouts.
OUTPUT PROVIDED:	Preliminary layout of preferred structure type.
TASKS:	Prepare preliminary bridge layouts. Calculate Preliminary Bridge End Stations. Check freeboard requirements. Select bridge type or types to investigate and make cost estimates. Request subsurface investigation. Prepare and study contour maps. Determine minimum roadway grade. Coordinate roadway grade and alignment. Prepare preliminary cost estimate. Determine railroad requirements.
START DEPENDENCIES:	Receipt of Hydraulics Report. Need Preliminary Alignment.
DISTRIBUTION AND USE:	Preconstruction for use in road plans preliminary plan-in-hand. Environmental for distribution to resource agencies for comment.

PROJECT ACTIVITY	
<u>Activity Title:</u>	Finalize General Bridge Layout for P.I.H
<u>Activity No.:</u>	570
<u>Responsible Unit:</u>	Bridge Bureau
<u>Activity Description:</u>	
DEFINITION:	Finalize General Layout for Bridge P.I.H
OUTPUT PROVIDED:	General Layout of preferred structure type for P.I.H
TASKS:	Draw cores. Select foundation Type. Prepare layout of preferred structure Type and alternates. Have design parameters meeting. Coordinate and schedule P.I.H Distribute prints for P.I.H
START DEPENDENCIES:	Receipt of subsurface investigation. Receipt of Plan and Profile sheet.
DISTRIBUTION AND USE:	Plan-in-Hand prints to Districts, Preconstruction, FHWA, Hydraulics; Counties, Cities, and other appropriate agencies. Used at Plan-in-Hand.
COMPLETED WHEN:	P.I.H arranged and P.I.H prints distributed.

PROJECT ACTIVITY	
<u>Activity Title:</u>	Plan-in-Hand Inspection.
<u>Activity No.:</u>	572
<u>Responsible Unit:</u>	Bridge Bureau
<u>Activity Description:</u>	
DEFINITION:	Inspection to review the grade and line, structure type and location, type of footings, drainage design and the overall project design. The plan-in-hand usually includes the same representatives as at the Field Review plus other involved parties (Fish, Wildlife and Parks, Traffic, Right-of-Way, Materials), depending upon the type of project and the extent of their involvement.
OUTPUT PROVIDED:	Approved general layout for bridge(s). Preliminary Plan-in-Hand Report.
TASKS:	<p>1. When Bridge Bureau is Manager:</p> <p>Engineer prepares the plans and related information for the preliminary plan-in-hand. Crew Chief receives prints of the preliminary right-of-way plans for the plan-in-hand inspection.</p> <p>Crew Chief develops the cover letter setting the proposed date for the plan-in-hand and distributes prints of plans and related information.</p> <p>Crew Chief conducts the office and field review of the plan-in-hand plans and obtains decisions on the following items in sufficient detail to prepare final right-of-way and construction plans:</p> <ol style="list-style-type: none"> <li>a. Alignment</li> <li>b. Grade</li> <li>c. Typical section</li> <li>d. Ditch widths</li> <li>e. Backslope</li> <li>f. Type of guardrail</li> <li>g. Layout of structure</li> <li>h. Type of footing</li> <li>i. Type of structure</li> <li>j. Alternate structure types</li> </ol>

PROJECT ACTIVITY	
<u>Activity Title:</u>	Plan-in-Hand Inspection.
<u>Activity No.:</u>	572 (Continued)
<u>Responsible Unit:</u>	Bridge Bureau
<u>Activity Description:</u>	
TASKS: (Continued)	
	<ul style="list-style-type: none"> <li>k. Location and geometric layout for special features</li> <li>l. Major irrigation and drainage features</li> <li>m. Major land service features</li> <li>n. Traffic Control Plan</li> </ul>
	<p>Crew Chief prepares the plan-in-hand report documenting decisions made and further studies agreed upon during the plan-in-hand inspection.</p>
	<p>Crew Chief distributes the plan-in-hand report and requests approval from the Bridge Engineer and comments by a specific date from the following:</p>
	<ul style="list-style-type: none"> <li>a. Chief Engineer</li> <li>b. District Engineer</li> <li>c. Other affected internal Bureaus and Sections</li> <li>d. Other affected public agencies</li> </ul>
	<p>Crew Chief receives comments and approval of the plan-in-hand report, amends the report, if required, and redistributes.</p>
	<p>Crew Chief requests special studies agreed upon at the plan-in-hand from any one or combination of the following:</p>
	<ul style="list-style-type: none"> <li>a. Right-of-Way Bureau</li> <li>b. Materials Bureau</li> <li>c. Road Design</li> <li>d. Traffic Bureau</li> <li>e. District Engineer</li> <li>f. Hydraulics Section</li> <li>g. Surfacing Unit</li> <li>h. Environmental Bureau</li> <li>i. Other Public Agencies</li> </ul>
	<p>Crew Chief obtains decisions on design problems from the Bridge Engineer.</p>

PROJECT ACTIVITY	
<u>Activity Title:</u>	Plan-in-Hand Inspection.
<u>Activity No.:</u>	572 (Continued)
<u>Responsible Unit:</u>	Bridge Bureau
<u>Activity Description:</u>	
TASKS: (Continued)	<p>Engineer designs structure components and features.</p> <p>Crew Chief furnishes construction plans and cross sections to the Utilities Section Supervisor for utilities and railroads involved.</p> <p>Crew Chief furnishes information to the Environmental Bureau for them to use in securing Section 106 clearance if necessary.</p> <p>Crew Chief transmits to the Engineering Information Services Section (with a copy to Fiscal Programming) an estimate of the cost of the project.</p> <p>Crew Chief receives pertinent data, develops potential solutions for major problems and obtains approval.</p> <p>2. When Bridge Bureau is Not Manager:</p> <p>Engineer prepares the plans and related information for the plan-in-hand.</p> <p>Crew Chief receives prints for the plan-in-hand inspection.</p> <p>Crew Chief attends the office and field review of the plan-in-hand plans and explains, discusses, or otherwise presents the Bridge Bureau's position on:</p> <ul style="list-style-type: none"> <li>a. Alignment</li> <li>b. Grade</li> <li>c. Typical Section</li> <li>d. Type of Guardrail</li> <li>e. Layout of Structure</li> <li>f. Type of Footing</li> <li>g. Type of Structure</li> <li>h. Alternate Structure Types</li> <li>i. Traffic Control Plan</li> </ul>

PROJECT ACTIVITY	
<u>Activity Title:</u>	Plan-in-Hand Inspection.
<u>Activity No.:</u>	572 (Continued)
<u>Responsible Unit:</u>	Bridge Bureau
<u>Activity Description:</u>	
TASKS: (Continued)	<p>Crew Chief reviews the plan-in-hand report, providing comments.</p> <p>Crew Chief initiates special analysis or investigations agreed upon at the plan-in-hand.</p> <p>Crew Chief obtains decisions on design problems from the Bridge Engineer.</p> <p>Engineer designs structure components and features.</p> <p>Crew Chief furnishes bridge plans to the Utilities Section Supervisor for utilities and railroads involved.</p> <p>Crew Chief transmits to the Project Manager (with a copy to Fiscal Programming) an estimate of the cost of the bridge.</p> <p>Crew Chief receives pertinent data, develops potential solutions for major problems.</p> <p>Crew Chief obtains decisions on design problems from the Design Engineer.</p> <p>Engineer designs structure components and features.</p> <p>Crew Chief furnishes information to the Environmental Bureau for them to use in securing Section 106 clearance if necessary.</p> <p>Crew Chief transmits to the Engineering Information Services Section (with a copy to Fiscal Programming) an estimate of the cost of the project.</p> <p>Crew Chief receives pertinent data, develops potential solutions for major problems and obtains approval.</p>



PROJECT ACTIVITY	
<u>Activity Title:</u>	Plan-in-Hand Inspection.
<u>Activity No.:</u>	572 (Continued)
<u>Responsible Unit:</u>	Bridge Bureau
<u>Activity Description:</u>	
START	
DEPENDENCIES:	Prepared plans for Plan-in-Hand.
DISTRIBUTION AND USE:	Used to begin final project design.
	Preliminary Plan-in-Hand Reports are distributed to: Chief Engineer Preconstruction Engineer District Engineer Other affected internal Bureaus and Sections Other affected public agencies

PROJECT ACTIVITY	
<u>Activity Title:</u>	Prepare Bridge Superstructure Design and Plans
<u>Activity No.:</u>	574
<u>Responsible Unit:</u>	Bridge Bureau
<u>Activity Description:</u>	
DEFINITION:	Prepare necessary design, plans, and specifications for the superstructure portion of the required bridge plans and specifications.
OUTPUT PROVIDED:	A ready-to-check set of superstructure plans and specifications.
TASKS:	Bridge superstructure design calculations. Check of superstructure design calculations. Detailing of superstructure plans. Design of bridge guardrail revisions. Detailing of bridge guardrail revisions. Design and detailing of miscellaneous features for other Bureaus, Sections, or Units.
START DEPENDENCIES:	Activity 560 – Bridge Model Analysis
DISTRIBUTION AND USE:	Bridge Superstructure Plans and Special Provisions to Bridge Area Engineer for final plans checking assignment.
COMPLETED WHEN:	Bridge Area Engineer is notified that bridge superstructure plans are ready for final checking.

PROJECT ACTIVITY	
<u>Activity Title:</u>	Approve Bridge Scope of Work Report
<u>Activity No.:</u>	576
<u>Responsible Unit:</u>	Bridge Bureau
<u>Activity Description:</u>	
DEFINITION:	Approval of written project scope.
OUTPUT PROVIDED:	Sign Scope of Work Report defining scope of work, design criteria and any special features.
TASKS:	Scope of work is defined based on design mapping, survey data, geotechnical data, typical section, environmental recommendations, right-of-way and utility report, traffic and hydraulic studies. Crew Chief submits the scope of work to the Bridge Engineer and the Bridge Engineer requests approval.
START DEPENDENCIES:	Prepare Scope of Work Concept Report.
DISTRIBUTION AND USE:	Approved Scope of Work Report is distributed to: <ul style="list-style-type: none"><li>a. Engineering Division Bureau Chiefs</li><li>b. District Administrator</li><li>c. Other parties affected by the project</li></ul>

PROJECT ACTIVITY	
<u>Activity Title:</u>	Prepare Bridge Substructure Design and Plans
<u>Activity No.:</u>	578
<u>Responsible Unit:</u>	Bridge Bureau
<u>Activity Description:</u>	
DEFINITION:	Prepare necessary design, plans, and specifications for the substructure portion of the required bridge plans and specifications.
OUTPUT PROVIDED:	A ready-to-check set of substructure plans and specifications.
TASKS:	Bridge substructure design calculations. Check of substructure design calculations. Detailing of substructure plans.
START DEPENDENCIES:	Activity 466, Geotechnical Engineering – Structures and Activity 574, Prepare Bridge Superstructure Design and Plans.
DISTRIBUTION AND USE:	Bridge Substructure Plans and Special Provisions to Bridge Area Engineer for final plans checking assignment.
COMPLETED WHEN:	Bridge Area Engineer is notified that bridge superstructure plans are ready for final check.

PROJECT ACTIVITY	
<u>Activity Title:</u>	Check Bridge Plans.
<u>Activity No.:</u>	580
<u>Responsible Unit:</u>	Bridge Bureau
<u>Activity Description:</u>	
OUTPUT PROVIDED:	Fully checked set of special provisions, plans and a cost estimate.
TASKS:	Checks and corrections as required of bridge plans and special provisions. Calculation of quantities Preparation of Quantities and Title Sheets Preparation of Engineer's Estimate Review by District and Bureau Staff
START DEPENDENCIES:	Completion of crew check of design, plans and draft of Special Provisions.  Completion of Road Plan Review Changes.
DISTRIBUTION AND USE:	Transmitted to Contract Plans Section for preparation of contract package.

**PROJECT ACTIVITY**

Activity Title: Transmit Final Plans

Activity No.: 595

Responsible Unit: Bridge Bureau

Activity Description:

DEFINITION: Transmit final plans, special provisions and cost estimates.

OUTPUT  
PROVIDED: Approved contract documents.

TASKS: Transmit plans, special provisions and cost estimates to Contract Plans and to the district.

START  
DEPENDENCIES: Check Bridge Plans.

DISTRIBUTION  
AND USE: Plans to Contract Plans for use in bidding package and to district for comment.

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## Chapter Three

# BRIDGE DESIGN COORDINATION

During the development of a bridge design project, the bridge designer must coordinate with many units internal and external to the Department. Chapter One describes the functional responsibilities of all of the Units within the Bridge Bureau, all of the Sections within the Engineering Division and selected Units outside of the Engineering Division. Chapter Two presents a network which describes the project development sequence for a bridge project. Chapter Three discusses specific coordination responsibilities between the bridge designer and other units. Together, the three chapters will provide an understanding of the necessary interaction among the various units in project development.

### 3.1 INTERNAL MDT UNITS

This Section discusses the specific coordination responsibilities between the bridge designer and other MDT units.

#### 3.1.1 Preconstruction Bureau

##### 3.1.1.1 Road Design Section

The following describes the coordination between the Bridge Bureau and the Road Design Section:

1. Roadway Geometrics. The road designer provides the Bridge Bureau with preliminary horizontal and vertical alignments. The bridge designer determines a preliminary structure length and depth of superstructure, and approximate bridge end elevations. The

road designer modifies the alignment as necessary, based on the preliminary grade recommendations from the bridge designer. The Bridge Bureau reviews and comments on the proposed roadway geometrics.

The Bridge Bureau determines the bridge width according to its criteria in the **Bridge Design Standards Manual**. However, the proposed bridge width will not be less than the roadway width in the Geometric Design Tables in Chapter Twelve of the **Montana Road Design Manual**.

2. Approach Roadway. Even where only minor roadway work is necessary at, for example, a bridge replacement, the Road Design Section is responsible for all roadway work.
3. Roadside Safety Appurtenances. The Bridge Bureau will select the type and design of the bridge rail. The road designer will determine the design of the approaching guardrail transition into the bridge rail.
4. Sidewalks. Sidewalk requirements on bridges will be determined jointly by the Bridge Bureau, the Road Design Section and the District.
5. Traffic Control Plan (TCP). The road designer is typically responsible for developing the requirements for the maintenance and protection of traffic during construction across any bridges within the project limits. This may include, for example, providing one lane of traffic across a two-lane, two-way bridge, providing a



detour around the bridge or, on a multilane facility, providing a crossover between the two roadways. The Bridge Bureau assists in the development of the proposed TCP. The Bridge Bureau may prepare additional TCP requirements.

The Bridge Bureau will develop traffic control requirements across the structure when part-width construction is used or when the removal of an existing structure (and the construction of the new structure) must be performed in a specific sequence.

Department units will submit specific TCP requirements to the lead agent, who will coordinate, resolve inconsistencies and combine them into a special provision for transmittal to the Contract Plans Section. Both the Construction Bureau and the District Office will review and comment on the overall TCP.

### 3.1.1.2 Hydraulics Section

The Hydraulics Section is responsible for hydrologic and hydraulic analyses for both roadway drainage appurtenances and bridge waterway openings. The following summarizes the coordination between the Bridge Bureau and Hydraulics Section:

1. New or Replacement Bridges. The Hydraulics Section will perform the following for the design of bridge waterway openings for new bridges:
  - a. the hydrologic analysis to calculate the design flow rates based on the drainage basin characteristics;
  - b. the hydraulic analysis to determine the necessary dimensions of the bridge waterway opening to pass the design flood, to meet the backwater allowances and to satisfy any regulatory flood plain

requirements; and

- c. the hydraulic scour analysis to assist in determining the proper foundation design for the new bridge.

Based on the hydraulic analysis, the Hydraulics Section will provide the following to the Bridge Bureau for new bridges:

- a. the water surface elevation for the design-year flood and the Q2 stage,
- b. a suggested low beam elevation,
- c. the necessary bridge waterway opening dimensions, skew angle and channel centerline station,
- d. the results of its hydraulic scour analysis, and
- e. riprap recommendations.

2. Existing Bridges. For hydraulic scour evaluations, the Hydraulics Section, Geotechnical Section and Bridge Bureau participate in an interdisciplinary team to evaluate the foundation design of an existing bridge and to determine if any corrective actions are warranted.

3. Culverts. In general, the Hydraulics Section is responsible for the design of box and pipe culverts (diameter > 600 mm). Occasionally, the Hydraulics Section may request the Bridge Bureau to check the structural adequacy of a proposed or existing culvert (e.g., for culvert extensions).
4. FEMA Regulations. The Hydraulics Section is responsible for determining that the bridge design is consistent with regulations promulgated by the Federal Emergency

Management Agency (e.g., development within regulatory flood plains).

5. Documentation. The Hydraulics Section will submit the necessary information to the Bridge Bureau documenting its recommendations for the hydraulic design of the bridge typically via a memorandum. The bridge designer will incorporate these details into the bridge design.

The road designer will strip cross sections from the DTM as needed.

### **3.1.1.3 Photogrammetry and Survey Section**

The Photogrammetry and Survey Section is responsible for conducting aerial and field surveys, in coordination with the District Office, for all Department projects. The following summarizes the Section's coordination with the Bridge Bureau:

1. Field Surveys. The decision that a field survey is needed is made at the Preliminary Field Review. The survey is then conducted by the District survey crews or a consultant. When the survey is completed and checked, it is made available on the server. The District will send a letter or e-mail informing design units that the survey is available and listing the survey filenames. When the survey information is obtained using a data collector, the Road Design Section will prepare a strip map and a digital terrain model (DTM) for the bridge designer's use in plan development.
2. Aerial Surveys. The decision that an aerial survey is needed is made at the Preliminary Field Review. The Photogrammetry and Survey Section plots the necessary flight lines and requests that targets be provided. A District survey crew will conduct the control traverse survey, hydraulic survey and will provide any needed additional survey information. The Photogrammetry and Survey Section will prepare a strip map and a digital terrain model of the project.

### 3.1.1.4 Consultant Design Bureau

The Department may use a consultant for a bridge design project. When a consultant is used, the Consultant Design Bureau is the primary contact with the consultant. The Bridge Bureau will provide technical support on the project and review the plans prepared by the consultant.

### 3.1.2 Environmental Bureau

The Environmental Bureau is responsible for a variety of activities related to environmental impacts and procedures. This includes air, noise and water quality analyses; biological, archeological and historical impacts; preparation of environmental documents for MDT projects; evaluation and mitigation of hazardous waste sites; and the public's involvement with the environmental document. The following summarizes the coordination between the Bridge Bureau and the Environmental Bureau:

1. Permits and Approvals. The Bridge Area Engineer provides the Environmental Bureau with the project information needed for securing several environmental permits approvals (when needed):
  - a. Section 402, Temporary Erosion Control permit (Department of Environmental Quality (DEQ) or the Federal EPA);
  - b. U.S. Army Corps of Engineers Section 404-Section 10 permit(s);
  - c. U.S. Fish and Wildlife, U.S. Forest Service, BLM approvals; and
  - d. any applicable regional, tribal and State permits (see Comment #10).

The Environmental Bureau coordinates with the applicable Federal or State agency and

processes the permit information and gains agency approval. The Environmental Bureau notifies the Bridge Bureau when the permit or approval is received.

2. NEPA and MEPA Requirements. The Bridge Bureau works with the Environmental Bureau to ensure that the project meets the Department's environmental and public input criteria pursuant to the National Environmental Policy Act and the Montana Environmental Policy Act. This includes project documentation (i.e., categorical exclusion, EA, EIS), water quality impacts, biological impacts, historical impacts, archeological impacts, and the need for public hearings. In general, the Environmental Bureau makes its determination of impacts based on input from the Bridge Bureau.
3. Section 4(f). A Section 4(f) approval is required if a project will impact publicly owned land (e.g., public park, recreational area, wildlife and waterfowl refuges). An approval will be granted only if there is no feasible and prudent alternative. Where a Section 4(f) approval is required, the Bridge Area Engineer will provide the necessary project information to the Environmental Bureau, who will then secure the approval.
4. Section 6(f). Federal law places restrictions on the use of land acquired with funds authorized by the Land and Water Conservation Act of 1965 as administered by the U.S. Department of Interior (Section 6(f) of the LWCF). Where a Section 6(f) approval is required, the Bridge Area Engineer will provide the necessary project information to the Environmental Bureau, who will then secure the approval.
5. Mitigation Features. The Environmental Bureau and Bridge Bureau work together on the plan for mitigation of environmental impacts.
6. Early Coordination. The Environmental Bureau determines the need for early

coordination on environmental issues with other State, Federal and public entities and makes all direct contacts, with input from the Bridge Bureau.

7. Stream Crossings. Because of the environmental sensitivities associated with all stream crossings, early coordination with the regulatory agencies is essential on bridge projects. Do not expend man-hours designing a bridge that does not have the necessary approvals from the regulatory agencies.

A three-step coordination process has been developed to ensure communication and coordination between MDT and the regulatory agencies. All submittals are in the form of a memorandum from the Bridge Engineer to the Resources Section Supervisor:

- a. The first submittal should be a General Layout as soon as a span arrangement is identified. Typically, at this time channel profiles and pier locations are also known. The first submittals should be identified as a "Concept Submittal for Review and Comment by Resource Agencies."
- b. The second submittal should be a General Layout as finalized at Plan-in-Hand. This layout has been developed sufficiently to show foundation type and the extent of the proposed riprap. This submittal should be identified as "Configuration Selected for Final Design." With the second submittal, request approval for size, type and location. Also include the type of riprap, the Q2 elevation, and the quantity of riprap below the Q2 elevation.
- c. The third submittal should be at the conclusion of plans checking at the same time distribution is made to the

District and to the Contract Plans Section. This submittal should be identified as "Plans for Final Review." This transmittal memorandum also needs to state whether or not the type and quantity of riprap has changed. If they have, include the changes.

8. Hazardous Wastes. The Environmental Bureau identifies all hazardous waste sites and determines any needed mitigation measures. The Bureau will coordinate the mitigation if it will be performed before letting the construction project to contract. They will provide the Bridge Bureau with any necessary provisions, and the bridge designer is responsible for incorporating these into the construction plans and specifications, if the hazardous waste removal or site mitigation will be accomplished by the bridge contractor.

Two specific types of hazardous waste which may require treatment for a bridge project include:

- a. removal of lead-based paint from an existing bridge, and
  - b. salvaging or disposing of treated timber from an existing bridge.
9. Erosion Control During Construction. Road design is responsible for developing a plan for temporary erosion control during construction. The Environmental Bureau will review and comment on the plan, and it will secure approval from the Montana Department of Environmental Quality or Federal EPA.
  10. Montana Department of Fish, Wildlife and Parks (MDFWP). The need for coordination with the MDFWP will be determined by the Environmental Bureau on a project-by-project basis. For example, a proposal to

replace an existing bridge over a waterway with a culvert must be evaluated for its potential impacts on fish passage.

11. Section 106. For all Federally funded projects, the Environmental Bureau must identify archeological and historic sites in the vicinity of the project, and these sites must be evaluated to determine if they are eligible for the National Register of Historic Places (NRHP). MDT submits recommendations for eligibility to the State Historic Preservation Officer (SHPO) for its concurrence. If a site is considered eligible for the NRHP and if the project will impact the site, the Department is mandated to mitigate the adverse effects. Mitigation is accomplished through written agreements among MDT, the Advisory Council on Historic Preservation and the Montana SHPO. A project cannot proceed unless the MDT's NRHP determination and any necessary mitigation measures are approved by SHPO.

12. Tribal and Intergovernmental Relations. When a bridge design project is on tribal land, the Bridge Bureau coordinates with the Environmental Bureau for the establishment of a TERO (Tribal Employment Rights Office) Agreement. For example, the bridge designer will submit a copy of the Preliminary Field Review Report and the Scope of Work Report to the Environmental Bureau Chief, who is the Tribal Coordinator.

13. Wetland Mitigation. For wetland mitigation sites, the Environmental Bureau will determine the location of the site, review the hydrology with the Hydraulics Section to ensure an adequate water supply, and provide a conceptual plan of the site. The Road Design Section is responsible for the preparation of plans, cross sections and summaries of quantities and for providing

any special provisions that apply to construction items.

### **3.1.3 Right-of-Way Bureau**

The Right-of-Way Bureau is responsible for all activities related to the legal right-of-way for the State highway system. This includes appraisals, acquisitions, relocation, property management and agreements with utility companies and railroad companies. In addition to right-of-way impacts, a bridge project may require coordination with the Right-of-Way Bureau, for example, if it includes utility attachments to the bridge or if it passes over a railroad.

Typically, the Road Design Section coordinates with the Right-of-Way Bureau, even for a bridge-lead project. The following summarizes the coordination between the Road Design Section and Right-of-Way Bureau:

- a. Coordination. The Road Design Section provides R/W with the needed design information to determine the right-of-way, utilities and railroad impacts.
- b. Plan Preparation. The road designer provides the R/W Bureau with a strip map and preliminary construction limits. The R/W Bureau is responsible for determining the R/W design, and the Bureau prepares a separate set of right-of-way plans for each project where right-of-way impacts exist.
- c. Acquisition. The R/W Bureau performs all right-of-way work and procures all takings and easements needed for the project. The Bureau notifies the Road Design Section of any design considerations resulting from negotiations with the property owners, and the Bureau will provide copies of signed agreements.
- d. Utility/Railroad Agreements. The road

designer places all utility information on the construction plans. After determining there are potential project impacts on utilities and/or railroads, the road designer initiates the process by providing the R/W Bureau with a set of plans denoting the utility conflicts and listing them by station and offset from centerline, and the two units work together during the process. The utilities that are potentially in conflict will also be placed on the cross sections by the road designer. R/W is the lead unit for contacts with utility/railroad companies and negotiates all agreements. Road Design ensures that the utility/railroad work is consistent with the bridge design. The road designer, as needed, incorporates the utility/railroad information into the plans.

Because of the unique nature of highway-railroad grade separations, special coordination must occur when a railroad alignment and a road alignment intersect. A preliminary layout is developed using the minimum horizontal and vertical clearances specified in Chapter Twenty of the **Montana Structures Manual**. The Bridge Area Engineer and Utilities Section will schedule a field review of the bridge site with the impacted railroad companies. The Area Engineer will submit the preliminary bridge layout to the Utilities Section for submission to the railroad company before the field review. The field review should evaluate railroad considerations which include:

- a. construction of future tracks,
- b. off-track maintenance roadways,
- c. longitudinal drainage requirements,
- d. high snow areas, and
- e. bent locations.

### **3.1.4 Deleted**

### **3.1.5 Construction Bureaus**

The Construction Engineer, in coordination with the District Offices, is responsible for oversight of the entire construction program, and administration of four separate Bureaus: Materials, Contract Plans, Construction Administration Services, and Construction Engineering Services.

The Construction Engineer receives copies of the Preliminary Field Review Report, Scope of Work Report, and Plan-in-Hand Report. In addition, the Construction Engineer receives the preliminary plans, which are distributed for the plan-in-hand review, and the final plan review.

#### **3.1.5.1 Materials Bureau**

The Materials Bureau is responsible for testing and certifying all materials used on Department projects. This includes geotechnical analyses and materials for pavements and structures. Normally, the District materials personnel perform the field sampling. The Geotechnical Section will perform the core drilling. The following summarizes the coordination between the Bridge Bureau and Materials Bureau:

1. Geotechnical Report. The Geotechnical Section prepares a Geotechnical Report for all new bridge projects. Based on the log of borings, the Report presents the soil and rock types, bearing capacities and foundation recommendations. The Bridge Bureau comments on the Geotechnical Report, if necessary, and works with the Geotechnical Section to resolve any conflicts.

The bridge designer incorporates the

relevant geotechnical information into the bridge design plans. More specifically, the bridge designer prepares the Log of Borings Detail for the Foundation Plan Sheet. The information from the Geotechnical Report is transferred to the Sheet in a form suitable for the construction plans. The information includes the borehole location and number, elevations and number of blows. See Section 5.4.3 for more information on the Log of Borings Detail. A full set of the log of borings is included in the Special Provisions.

2. Foundation Type and Design. The foundation type may be a spread footing, piles or drilled shaft. The selection of the foundation type is a collaborative effort between the Bridge Bureau and Geotechnical Section based on the Geotechnical Report, expected superstructure type, scour potential, etc. In summary, the coordination works as follows:

- a. Piles. The Bridge Bureau provides the Geotechnical Section with the applicable loads and an initial recommendation to use piles and their type. The Geotechnical Section approves the use of piles and the pile type, and the Section provides the Bridge Bureau with the allowable stresses, deflection values, lateral loads, depth versus axial capacity curves, depth versus lateral capacity curves, etc.
- b. Spread Footings. The Bridge Bureau provides the Geotechnical Section with the applicable loads and a recommendation to use a spread footing. The Geotechnical Section approves the use of spread footings, and the Section provides the Bridge Bureau with the allowable footing pressure.

- c. Drilled Shafts. The Bridge Bureau provides the Geotechnical Section with the applicable loads and an initial recommendation to use drilled shafts. The Geotechnical Section approves the use of drilled shafts, and the Section provides the Bridge Bureau with the moment and shear diagrams, deflection values, depth and diameter of shaft, etc.

Once the foundation type and basic dimensions are selected, the Bridge Bureau typically performs the detailed structural design of the foundation.

3. Scour. For hydraulic scour evaluations at existing bridges, the Hydraulics Section, Geotechnical Section and Bridge Bureau participate in an interdisciplinary team to evaluate the existing foundation design and to determine if any corrective actions are warranted.
4. Walls. The Geotechnical Section and Bridge Bureau typically collaborate on the design of retaining walls. The Bridge Bureau is responsible for the design of cast-in-place retaining walls. The Geotechnical Section is responsible for the design of reinforced earth structures, bin walls and gabions, where used.
5. Bridge Deck Rehabilitation. The Bridge Bureau retains the services of a consultant to collect data. This includes testing of concrete for chloride content analysis, core samples, half-cell tests and chain drag to evaluate the deck condition.
6. Materials. The Materials Bureau samples and tests materials on all projects with structural design elements and develops construction specifications on structural items. The materials include steel, concrete, paint, corrugated metal pipe, etc. The tests and specifications are based on the

AASHTO **Standard Specifications for Transportation Materials and Methods of Sampling and Testing** and Department practices. The Materials Bureau certifies the use of materials on bridge projects.

7. Shop Fabrication. The Bridge Bureau and Materials Bureau collaborate to inspect the shop fabrication of structural steel, prestressed concrete girders, post-tensioned concrete girders and other structural items.
8. New Materials and Experimental Items. The Bridge Bureau determines the need for new materials and/or experimental items in the project, and it develops the specifications and special provisions for the items. The Bridge Bureau collaborates with the Materials Bureau on materials testing and sampling. The bridge designer incorporates this information into the final contract document.

### **3.1.5.2 Contract Plans Bureau**

The Bridge Bureau and Contract Plans Bureau coordinate on the following:

1. Bridge Design Plans. After the bridge design plans have been finalized, the Bridge Area Engineer transmits the plans to the Contract Plans Bureau, who then circulates the plans to interested parties for comment. The Bridge Area Engineer will review the comments and revise the plans as needed.
2. Special Provisions. The bridge designer is responsible for the development of any necessary special provisions relating to the bridge design items for the project. The Contract Plans Bureau ensures that these are included within the final contract document.

### **3.1.5.3 Construction Administration Services Bureau**

The Construction Administration Services Bureau includes Change Order, Construction Systems and Construction budgeting functions, as well as the Contractor Payment and Specification Sections.

The Bridge Bureau collaborates with the Construction Administration Services Bureau in the development of Standard and Supplemental Specifications. The Bridge Bureau reviews most proposed changes to Sections 551, 552, 553, 555, 556, 557, 558, 559, 706, and 711 of the **Standard Specifications for Road and Bridge Construction**.

### **3.1.5.4 Construction Engineering Services Bureau**

The Construction Engineering Services Bureau is responsible for issuing direction on technical construction issues, general construction issue resolution, construction oversight and uniformity, construction review findings, Change Order discussions, Value Engineering proposal investigation and recommendation, non-uniformity complaint resolution and implementation of new construction processes, procedures and specifications.

The following summarizes the Bridge Bureau's coordination with the Construction Engineering Services Bureau:

1. New Materials, Techniques or Construction Practices. When a bridge design proposes the use of materials, construction techniques or construction practices not previously used in Montana, the proposal must be reviewed by the Construction Bureau for practicality and constructability.



2. Field Inspections. The Bridge Bureau coordinates with Construction and the District on its periodic field inspections (e.g., for post-tensioning operations).
  3. Shop Drawings. The Bridge Bureau is responsible for the review of all structural shop drawings submitted by the contractor (e.g., for structural steel, prestressed concrete beams, erection). The Bridge Bureau coordinates its review with Construction and the District.
  4. Technical Assistance. The Bridge Bureau provides technical assistance as requested for construction of structural items (e.g., to resolve construction problems).
  5. Change Orders. The Bridge Bureau receives and comments on all bridge-related construction change orders and works with Construction and the District to resolve any issues.
  6. Claims. For claim reviews related to structural items, Construction may seek input from the Bridge Bureau.
1. Sign Structures. For overhead sign structures, the Contractor typically performs the structural analysis, and the Bridge Bureau reviews and approves the shop drawings. For cantilever signs, the Signing Unit typically uses a standard design. The Bridge Bureau prepares a new design if there is a special problem (e.g., poor soils) in coordination with the Geotechnical Section. The Signing Unit will provide the Soils Survey Report to the Geotechnical Section. Once completed, the Bridge Bureau will submit the cantilever design to the Signing Unit for incorporation into the signing plans.
  2. Bridge-Lead Project. These projects (e.g., bridge deck rehabilitation) typically require input from the Signing Unit on pavement markings and signing at the bridge.
  3. Signs on Bridges. If the Signing Unit proposes to place a sign on a bridge, the Unit must coordinate with the Bridge Bureau.

### **3.1.6 Traffic and Safety Bureau**

#### **3.1.6.1 Traffic Engineering Section**

The following describes the bridge designer's coordination with the Traffic Engineering Section.

#### Signing Unit

The Signing Unit is responsible for the selection, design and placement of signs and pavement markings on most MDT projects. The following describes the coordination between the Signing Unit and Bridge Bureau:

#### Electrical Unit

The Electrical Unit is responsible for the selection, design and placement of traffic signals and highway lighting on most MDT projects. The following describes the coordination between the Electrical Unit and Bridge Bureau:

1. Structural Support. For most traffic signal and highway lighting installations, standard foundation sizes are used. These foundations have been designed for luminaire poles and signal poles with mast-arm lengths up to 50 ft (15 m). Where signal poles with a mast-arm length greater than 50 ft (15 m) are used, the pole manufacturer is responsible for any structural analysis and pole design. The Geotechnical Section or the Contractor may

be responsible for the foundation design where non-standard poles are used or where there are unusual soil conditions. If a Consultant or Contractor designs footings, the Geotechnical Section reviews the design, in coordination with the Bridge Bureau.

The manufacturer will typically prepare a set of shop drawings and specifications for the supports. These are submitted to the Electrical Unit through the Construction Review Section. After review by the Electrical Unit, the Bridge Bureau reviews the shop drawings and specifications for structural elements only.

2. Electrical Work on Bridges. Lighting and/or traffic signal installations may be warranted on or in the vicinity of bridges. The Electrical Unit will coordinate with the Bridge Bureau (e.g., for placement of conduits on the bridge) for the electrical work. The Bridge Bureau will determine the structural support for any luminaires which may be attached to the bridge.

#### Safety Design Unit

Where the Safety Design Unit is the lead and the project involves bridge work, the coordination between the Safety Design Unit and Bridge Bureau is the same as the coordination between the Road Design Section and Bridge Bureau.

#### **3.1.6.2 Safety Management Section**

The Safety Management Section is responsible for providing the crash history on Department projects. The review should identify crash trends or crash characteristics and any crash cluster in the project area. The Section provides the bridge designer with the crash data and statistical trends for use in project design. The bridge designer shares this information with the

Road Design Section for evaluation and identification of any corrective action and/or safety improvement.

#### **3.1.7 Rail, Transit and Planning Division**

The Rail, Transit and Planning Division provides the Bridge Bureau with the necessary programming papers to initiate the bridge design process. The Bridge Area Engineer submits the following to the Transportation Planning Division:

1. the Preliminary Field Review Report, and
2. the Project Scope of Work Report.

The Bridge Area Engineer also requests traffic data for projects from the Rail, Transit and Planning Division. The Division obtains the data which includes average annual daily traffic, design hourly volume, percentage of trucks, and the daily equivalent single-axle loads (ESAL). The data should also include any major changes in traffic volumes within the project limits.

Public Affairs within the Rail, Transit and Planning Division is the primary focal point for all contact with the general public. This includes preparing news releases of upcoming MDT work and coordinating the presentation of public hearings and informal public meetings. On bridge design projects, the Bridge Bureau coordinates with Public Affairs on any public contacts.

#### **3.1.8 MDT District Offices**

The Department's five District Offices (Missoula, Butte, Great Falls, Glendive and Billings) provide the field services needed within each geographic area. Their responsibilities include maintenance of the State highway system, construction inspection services, contacts with county and city governments, and traffic-related activities (e.g.,

approach permits). Section 3.1.5 discusses the coordination between the Bridge Bureau and District Office for construction activities. For preconstruction activities, the following summarizes the coordination between the Bridge Design Section and District Offices:

1. General. In general, the Bridge Design Section will maintain a steady contact with the District Office. The District Office, for example, will be invited to all field reviews and will receive all project-related correspondence.
2. Design Coordination Meetings. These are held in the District Office, and the Bridge Area Engineer typically attends all design coordination meetings.
3. Aerial Survey. When an aerial survey is conducted, the District Office is responsible for the "pick-up" field survey to locate items which may be missed by the aerial survey (e.g., underground utilities). For bridge projects, the District conveys this information to the Road Design Section for plotting.
4. Informal Public Meetings. The District Office or the Bridge Area Engineer requests Public Affairs (within the Rail, Transit and Planning Division) to schedule both informal and formal public meetings. The District is responsible for finding a facility in which to hold the meeting.
5. Temporary Traffic Control. District personnel review the proposed temporary traffic control plan prepared by the Road Design Section and modify it as needed. The District also provides a quantity estimate for traffic control units required for the project.

### **3.1.9 Engineering Information Services Section**

The Montana Department of Transportation's Engineering Information Services Section maintains, administers, and provides training and support for the Department's Computer Aided Design system, Program and Project Management System and Document Management System; develops and maintains three-dimensional visualization documents/animations; and provides, monitors and reviews Preliminary Engineering Costs for Federal-Aid projects.

#### **3.1.9.1 Engineering Management Unit**

The Engineering Management Unit (EMU) is responsible for updating, customizing and maintaining, the Program and Project Management System (PPMS) and for providing support and training to the end users. This section also provides, monitors and reviews preliminary engineering cost on federal-aid projects. For project management coordination see section 4.4.

#### **3.1.10 Motor Carrier Services**

Motor Carrier Services is responsible for monitoring and regulating truck traffic within the State of Montana. Where the Motor Carrier Services is reviewing an overload vehicle permit request, it coordinates with the Bridge Management Section to ensure that any bridges within the proposed route can sustain the overload.

#### **3.1.11 Legal Services Division**

The Legal Services Division is responsible for providing all legal counsel required by MDT (e.g., interpretation of State laws on highway work). In its administration of bridge design projects, the Bridge Bureau is responsible for

preparing and processing, where applicable, agreements with other entities. Once prepared, the Legal Services Division reviews, comments on and approves the text of the proposed Agreement. On certain controversial issues, a single staff person in Legal Services may be designated as the sole contact person between MDT and the public or other agencies.

### **3.1.12 Human Resources Division**

On a project level, the Bridge Bureau coordinates with the Human Resources Division, Civil Rights Bureau, to ensure compliance with the *Americans with Disabilities Act*. The Division will, for example, provide interpretations on the intent and application of the *Act*.

### 3.2 EXTERNAL UNITS

This Section discusses the specific coordination activities between the Bridge Bureau and selected major units external to MDT.

#### 3.2.1 Federal Agencies

##### 3.2.1.1 Federal Highway Administration

The Federal Highway Administration (FHWA) administers the Federal-aid program which funds eligible highway improvements nationwide. Their basic responsibility is to ensure that the State DOTs comply with all applicable Federal laws in their expenditure of Federal funds and to ensure that the State DOTs meet the applicable engineering requirements for their proposed highway projects. FHWA maintains a Division Office within each State, and this is the primary point of contact for a State DOT.

The following statements summarize the Bridge Bureau's coordination with the FHWA Montana Division Office:

1. Federal Surface Transportation Legislation. Chapter Eight of the **Montana Road Design Manual** describes the FHWA involvement for Federal-aid projects which has resulted from Federal Surface Transportation Legislation. The Chapter presents a table which identifies the FHWA involvement for different project activities (e.g., design exception) and for different project types (e.g., new construction project on the National Highway System).
2. NHS. In general, FHWA is invited to all field reviews and receives copies of all major reports (e.g., Scope of Work Report) on National Highway System projects. FHWA has regular involvement with all NHS projects. FHWA must approve the

Scope of Work and all design exceptions for these projects.

3. State-Wide Practices. The Bridge Bureau seeks FHWA input into and approval of all projects with Federal funding, design policies, practices and criteria which will have a widespread application (e.g., **MDT Detailed Drawings, MDT Structures Manual**, blanket design exceptions).

##### 3.2.1.2 United States Forest Service (USFS)

The USFS is responsible for the management of all national forests. The USFS and the MDT currently have a Memorandum of Understanding (MOU) and approved procedures that describe the coordination between the two agencies for the planning and the development of projects having USFS involvement. If a proposed bridge design project will impact a national forest, the Bridge Bureau must coordinate the project development with the USFS. The USFS will, for example, be invited to any field reviews and receive copies of major project reports (e.g., Scope of Work Report). In some cases, project actions will require USFS approval (e.g., right-of-way acquisition).

##### 3.2.1.3 National Park Service (NPS)

Coordination with the NPS will be necessary where bridge projects are in the vicinity of land under the jurisdiction of the NPS. Although the Department has no formal agreement with the NPS, the level of involvement on projects will be similar to that between the MDT and the USFS.

#### 3.2.2 Local Governments

The following describes the coordination between the Bridge Bureau and local governments:

1. Design. The Bridge Bureau solicits input from the local government on bridge design projects in that locality and, in general, keeps the local governments up-to-date on any current or planned activities.
2. Coordination. The Bridge Bureau typically invites the local government to any field reviews and provides the local government with copies of major project reports (e.g., Scope of Work Report).
3. Assistance. The Bridge Bureau provides technical assistance to the city and county governments, upon request. The Bridge Bureau responds to any verbal or written inquiries from local governments on bridge design issues.

## Chapter Four

# ADMINISTRATIVE POLICIES AND PROCEDURES

This Chapter discusses several items related to the operational practices of the MDT Bridge Bureau. It contains information on the preparation of in-house project reports, outside correspondence, memoranda, meetings, manpower estimates, selected personnel policies, local agreements and administration of consultant projects.

### 4.1 PROJECT REPORTS

This Section provides information on how to prepare the Department's project reports including the Preliminary Field Review Report, Scope of Work Report, Design Parameters Report and Plan-in-Hand Report. When used as described, this information will provide consistent, accurate and appropriate project reports.

#### 4.1.1 Preliminary Field Review Report

##### 4.1.1.1 General

A preliminary field review is conducted after a project is nominated to identify site characteristics, major design features, project-related issues and potential problems. Representatives who typically attend the review are listed in Section 4.1.1.2. The Preliminary Field Review (PFR) Report provides written documentation of all major determinations made during the preliminary field review meeting. It should discuss the major project design features, the potential involvement by other Units and provide a general overview of proposed improvements. The following procedures will apply to preparing the Report:

1. Preparation. The Bridge Area Engineer is responsible for the preparation of the PFR Report. The Report should be organized using the format discussed in Section 4.1.1.2. For projects managed by other Bureaus or Sections, the Bridge Bureau will supply the necessary structural information to the applicable Design Project Manager to allow preparation of the PFR Report.
2. Signature. Prepare the PFR Report for the Bridge Area Engineer's approval. The report should be sent through the Bridge Design Engineer.
3. Distribution. After the Bridge Engineer has approved the Report, copies of the PFR Report will typically be distributed to the project file and to the following individuals:
  - a. District Administrator;
  - b. Engineering Bureau Chiefs:
    - i. Construction
    - ii. Traffic and Safety
    - iii. Materials
    - iv. Right of Way
    - v. Preconstruction
    - vi. Environmental
  - c. Program Development Engineer;
  - d. Rail, Transit and Planning Division Administrator;
  - e. Fiscal Programming and Analysis Bureau;

- f. Preconstruction Section Heads;
    - i. Road Design
    - ii. Hydraulics
    - iii. Utilities
  - g. Supervisor, Geotechnical Section
  - h. Supervisor, Research Section
  - i. Supervisor, Survey Section;
  - j. Manager, Engineering Information Services Section;
  - k. Supervisor, Hazardous Materials
  - l. FHWA (on NHS or Interstate projects);
  - m. Bridge Management Engineer;
  - n. Bridge File
  - o. County Commissioners and local officials, where appropriate; and
  - p. any other individuals or units deemed appropriate.
4. Comments. All parties receiving a copy of the PFR Report are requested to provide comments on the Report. Concurrence of the Report will be assumed if no comments are received by the specified date. Once final the Report will be available on the Document Management System (DMS).

#### 4.1.1.2 Format and Content

In general, prepare the Preliminary Field Review (PFR) Report in the order and format discussed below. This will provide a uniform presentation for all Department PFR Reports and will ensure that all appropriate information will be addressed. Not all of the subject areas listed below will be required for every PFR Report,

and adjustments will be necessary to the Report as appropriate. The level of coverage for each item will also vary from project to project. Although in-depth coverage of the individual design details is usually not provided in this Report, provide sufficient detail to allow the reader to fully understand the proposed project.

Figure 4.1A illustrates the preferred format for the first page of the PFR Report. The preparer should note that the heading must be completely filled out, including the project number, project name, control number and project work type. The project work type is a three-digit number used by the Department to identify the main focus of an intended project. It can be found on the project program documents. However, for reference, they are also listed in Figure 4.1B. Note that the Distribution list is included on the first page of the Report.

The following provides the topic areas, in order, that should be addressed in the PFR Report, see Figure 4.1.A.1 for basic report outline:

1. Introduction. The introduction should include the date of the field review and provide a list of individuals who attended the review. The listing should also include the individual's title and office location. Depending on the project, representatives at a field review may include:
  - a. the Bridge Area Engineer/Design Project Manager,
  - b. bridge designer,
  - c. the Road Design Project Supervisor or designer,
  - d. the District Administrator,
  - e. the Maintenance Chief,
  - f. the Engineering Services Supervisor,



- g. a representative from the Consultant Design Section,
- h. a representative from the Hydraulics Section,
- i. a representative from the Environmental Bureau,
- j. a representative from the Right-of-Way and Utilities Bureau,
- k. a representative from the District Construction Office,
- l. a representative from the Geotechnical Section,
- m. FHWA (if applicable),
- n. local officials (if deemed appropriate),
- o. MCS – if project involves one of the following:
  - i. Permanent weigh facility in project limits
  - ii. Construction of a weigh facility including Type A or Type B
  - iii. ITS (Intelligent Transportation System) or AVI (Automated Vehicle Identification)
- p. ADA Coordinator, and
- q. Others as deemed as appropriate.

In general, the Design Project Manager should limit the number of attendees to those needed.



Montana Department of Transportation  
PO Box 201001  
Helena, Montana 59620-1001

# Memorandum

To: (Name)  
Bridge Engineer

Through: (Name)  
Bridge Design Engineer

From: (Name)  
Bridge Area Engineer

Date: (Date signed by Bridge Design Engineer)

Subject: (FHWA Number)  
(Location)  
(UPN)  
(Project Work Type Number/See Figure 4.1B)

Please approve the Preliminary Field Review Report for the subject project.

Approved \_\_\_\_\_  
Bridge Engineer Date

Delivered to Engineering Information Services Section \_\_\_\_\_  
Date Initial

We are requesting comments from the individuals on the following distribution list. We will assume concurrence if no comments are received within two weeks of the about approved date.

(UPN-PFR)

## **Distribution: /With Copy Attached**

\*District Administrator (e-mail)

Chief, Right of Way Bureau

Eng. Service's Eng./Sup

Administrator (Rail, Transit & Planning Div.)

Administrator (Maintenance Div.)

Chief Engineer, Engineering Div.

Preconstruction Engineer

Highways Engineer

Materials Engineer

Construction Engineer

Traffic and Safety Engineer

Safety Management Engineer

FHWA / District Operations Engineer

Bridge Management Engineer Chief, (e-mail)

Environmental Bureau

Chief, Fiscal Programming Bureau

Manager, Eng. Info. Services Section (EISS)

Supervisor, Survey and Mapping Section

Supervisor, Utilities Section

Supervisor, Research & Development Section

Supervisor, Secondary Roads

MCS

ADA Coordinator

County and/or Local Governments



*Montana Department of Transportation  
PO Box 201001  
Helena, Montana 59620-1001*

### **Preliminary Field Review Report**

The field review for the subject project was held on 01/11/04. The following Personnel were in attendance –

(Names)

(Body of Report)

- |                                  |   |
|----------------------------------|---|
| 1. Introduction                  | 16. Salvage                             |
| 2. Proposed Scope of Work        | 17. Public Involvement                  |
| 3. Project Location and Limits   | 18. Other Projects                      |
| 4. Physical Characteristics      | 19. Ready/Letting Date                  |
| 5. Traffic Data                  | 20. Management                          |
| 6. Accident History              | 21. Preliminary Cost Estimate           |
| 7. Major Design Features         | 22. Location Map                        |
| 8. Design Exceptions             | 23. Preliminary Field Review Work Sheet |
| 9. Right-of-Way                  | 24. Hydraulics Study Report             |
| 10. Utilities/Rail Roads         | 25. Tribal Coordination                 |
| 11. Environmental Considerations |   |
| 12. Stream Access                |   |
| 13. Traffic Control              |   |
| 14. Survey                       |   |
| 15. Materials                    |   |

### **PRELIMINARY FIELD REVIEW REPORT MEMORANDUM**

Figure 4.1A.1

Type	Description
210	<b>New Bridge</b> Construction of a new bridge, which does not replace or relocate an existing bridge.
220	<b>Bridge Replacement with added capacity</b> The total replacement of a structurally deficient, or functionally obsolete bridge with a new bridge in the same general traffic corridor. The replacement bridge is designed for an increased traffic flow by accommodation additional through lanes. Construction of a dual structure to alleviate a capacity deficiency is also included. The new bridge carries all of the through traffic with the old bridge retained for local service only, removed, closed or converted to a purpose other than carrying through traffic.
221	<b>Bridge Replacement with no added capacity</b> The total replacement of a structurally deficient or functionally obsolete bridge with a new bridge in the same general traffic corridor. The replacement bridge is not designed for capacity over the previous facility. The new bridge carries all of the through traffic with the old bridge retained for local service only, removed, closed or converted to a purpose other than carrying through traffic.
222	<b>Bridge Replacement with a culvert with no added capacity</b> The structurally deficient or functionally obsolete bridge is replaced by a culvert that accommodates the same number of lanes as the replaced bridge. The old bridge is retained for local service only, removed, closed or converted to a purpose other than carrying through traffic.
223	<b>Bridge Replacement with a culvert while adding capacity</b> The structurally deficient, or functionally obsolete bridge, is replaced by a culvert with adequate length to accommodate additional through lanes. The old bridge is retained for local service only, removed, closed or converted to a purpose other than carrying through traffic.
230	<b>Bridge Rehabilitation with added capacity</b> Major bridge rehabilitation to restore the structural integrity of a bridge as well as work necessary to correct major safety defects. Bridge deck replacement (both partial and complete) and the widening of bridges by widening lanes or adding lanes are included. Construction of a dual structure to alleviate a capacity deficiency is also included when the old structure is included in the dual structure.
231	<b>Major Bridge Rehabilitation without added capacity</b> The major work required to restore the structural integrity, do a seismic retrofit, or correct major safety defects. Bridge deck replacement (both partial and complete) is included
232	<b>Minor Bridge Rehabilitation</b> Work required to correct minor structure and safety defect of deficiencies, such as deck patching, deck resurfacing, deck protective systems, upgrading railings, curbs and gutters, and other minor bridge work.

Note: A complete list of Project Work Type Codes is located on the Intranet

1. Proposed Scope of Work. This section should provide a very brief description of the proposed scope of work for the project. For example, "The proposed project has been nominated to replace the existing 24 ft (7.2 m) wide bridge over the Madison River on US Highway 287 in Ennis. The new bridge will be constructed on a new alignment." The scope should indicate whether the project is a new structure, replacement structure or rehabilitated structure. The scope of work section should also include a brief discussion explaining the reason why the proposed scope of work was selected.

If it is determined that an outside consultant should be considered for the design of the project, indicate the division of expected responsibilities between MDT and the consultant.

2. Project Location and Limits. Some of the descriptions that may be used to briefly describe the project location include:
  - a. county name;
  - b. city or town name;
  - c. Indian reservation;
  - d. route number;
  - e. functional classification;
  - f. reference points;
  - g. project length;
  - h. location with respect to existing structures;
  - i. crossing feature (e.g., river, highway, railroad) and name;

- j. crossing routes and/or local streets;
- k. distance and direction from nearby cities or towns;
- l. as-built project numbers;
- m. adjacent project numbers; and
- n. direction of the proposed project.

Whenever the stationing proceeds in the opposite direction from the reference points (e.g., stationing increases from north to south while the reference points increases from south to north), note this in the Report.

3. Physical Characteristics. A brief description of the project's physical characteristics may include a discussion of the following:

- a. year when the existing bridge and roadway were built, reconstructed or rehabilitated;
- b. width, length and number of spans of existing structure;
- c. approach roadway widths;
- d. if available, the load capacity of the existing structure;
- e. if available, sufficiency rating;
- f. type of structure (e.g., prestressed concrete, structural steel); also list any special materials (e.g., timber, lead paint);
- g. any structural deficiencies (e.g., joint failures, spalling, delamination);
- h. rural or urban location;

- i. general description of the existing horizontal and vertical alignment; note all features which do not meet the Department's design criteria;
  - j. vertical clearance of the structure;
  - k. adequacy of waterway hydraulics; where necessary, include a description of the major waterway features (e.g., width, location of bends, 100-year flood elevation); and
  - l. any other unique physical characteristics related to the project.
4. Traffic Data. If available, include the following traffic data in the PFR Report:
- a. current AADT,
  - b. letting date AADT,
  - c. design year AADT,
  - d. DHV,
  - e. traffic distribution (D),
  - f. number and percent of trucks (T), and
  - g. the expected daily 18 kip (8165 kg) Equivalent Single Axle Load (ESAL), if paved.
5. Accident History. This section should briefly summarize the following accident history data:
- a. number of accidents;
  - b. types of accidents;
  - c. overall accident and severity rates for the project location;
  - d. Statewide accident and severity rates for similar routes (if available);
  - e. a description of how the project compares to the Statewide averages; and
  - f. if applicable, a brief description of why a higher than normal number of accidents may be occurring and proposed counter-measures to be investigated.
6. Major Design Features. The PFR Report should provide a general discussion for each of the following pertinent design features:
- a. Functional Classification. Note the functional classification of the highway (e.g., urban arterial, rural collector, rural local road).
  - b. Design Speed. This section should indicate the proposed design speed for the project. If more than one design speed is selected for the project (e.g., multiple bridges), then indicate the proposed design speed for each structure. For existing structures, also identify the existing posted speed limit.
  - c. Horizontal Alignment. Identify all major horizontal alignment features for the proposed project, including all features which may not meet the Department's design criteria. This includes the horizontal alignment for both the structure itself and for the approaches. Also, indicate the roadway alignment that can be reasonably obtained and possible methods for improving the horizontal alignment. Discuss the practicality of a new alignment, offset and parallel to the existing alignment for all reconstruction projects.

- d. Vertical Alignment. Provide a description for all major vertical alignment features on the proposed project. This discussion may identify any longitudinal grades which exceed the Department's design criteria, the vertical alignment that can be reasonably obtained, possible methods for improving the vertical alignment and existing and proposed vertical clearances.
  - e. Typical Sections. Provide a discussion on the proposed typical section of the project. This includes the overall structure width, number of travel lanes, travel lane widths, shoulder widths, sidewalks, type of bridge rail, etc.
  - f. Geotechnical Considerations. This section should provide a brief discussion on the major geotechnical considerations and techniques that may be required to construct the project (e.g., soil types, slope stability options, pier foundations).
  - g. Hydraulics. Include a discussion for the major hydraulic design elements on the project (e.g., 100-year flood elevation, backwater, freeboard, scour, ice/debris potential). If the Hydraulics Study Report is attached, this section of the PFR Report will only need to reference the report.
  - h. Traffic and Safety. This section should include a brief discussion of Traffic and Safety features.
  - i. Miscellaneous Features. This section should provide a discussion for all major design elements which are not identified in one of the above design areas. Miscellaneous features may include structure removal, retaining walls, lighting, overhead signs and utility attachments, etc.
- 7. Design Exceptions. If known at this stage, list all proposed design exceptions with a brief discussion of why an exception is considered necessary.
  - 8. Right-of-Way. Briefly describe existing and proposed right-of-way widths. Provide separate descriptions wherever the existing or proposed right-of-way is significantly different between various bridges on a project. If known, include a list of the major right-of-way acquisitions and the type of right-of-way required (e.g., taking of commercial property, temporary easements).
  - 9. Utilities/Railroads. Include a list of all known utility and/or railroad companies that may be affected by the project. For utilities, note their location and how they may affect the project.
  - 10. Environmental Considerations. Identify any major environmental concerns on the project (e.g., hazardous waste sites, historical bridges, waterways, wetlands, archaeological/cultural sites).
  - 11. Stream Access. Note existing stream access points and stream usage including existing fencing and parking in the vicinity of the project. Note the stream's apparent recreational value to the general public and any public or private access that might be affected by the project. Assess and document the anticipated right of way needs to maintain the existing access. Document any requested or anticipated enhancements to the existing conditions. Note: Refer to Management Memo Number 02-01, Effective 03-01-02 for additional guidance.
  - 12. Traffic Control. Present the proposed traffic control procedure planned for the

construction zone (e.g., detours, lane closures, shifting traffic, crossovers).

13. Survey. Address the need for a survey and the recommended survey methodology. Attach a complete Survey Request Form.
14. Materials. If known, provide a list of special materials that may be required on the project (e.g., geotechnical fabrics, quick curing concrete). This section should also discuss the need for a soils survey.
15. Salvage. For existing county bridges, list which elements the county may want to salvage.
16. Public Involvement. This section should address the type of public involvement required. This may include meetings with local officials, an early public involvement meeting and/or a formal public hearing. Also include the proposed approach for distributing project information to the public.
17. Other Projects. This section should identify all other projects that are currently under construction or will be in the near future that may affect this project. Where practical, the PFR Report may recommend that this project be incorporated into an existing or future project.
18. Ready Date and Letting Date. Note the year funding is anticipated for the project and that a ready date will be set after the overrides are complete. As a minimum the project ready date is typically three months prior to the letting date.
19. Management. List who the lead agency will be for the project. For in-house designs, the lead agency for bridge replacement or rehabilitation projects will normally be the Bridge Bureau. Complex projects will

normally be managed by the Road Design Section from the beginning. If it is determined during the course of project development that a culvert is appropriate for a bridge replacement project the agency lead is transferred from the Bridge Bureau to the Preconstruction Bureau after the scope of work is approved. For consultant projects, the Consultant Design Bureau will be the lead agency.

20. Preliminary Cost Estimate. Provide a preliminary cost estimate based on the proposed scope of work. Separate the structure costs, roadway costs and removal cost. Add 10% for contingencies, then add 15% for construction engineering, and then 3% per year for inflation based on the total cost of all project elements.
21. Location Map. Include a map showing the location of the project. And, if necessary, an aerial photo may also be included.
22. Preliminary Field Review Work Sheet. At the Bridge Area Engineer's discretion, a completed Preliminary Field Review Work Sheet may be attached to the PFR Report. The Work Sheet will provide additional information to the reader which may not be covered elsewhere in the PFR Report. A blank Preliminary Field Review Work Sheet form is provided at the end of this chapter.
23. Hydraulics Study Report. If available, attach the Hydraulics Study Report to the PFR Report. This Report will be prepared by the Hydraulics Section.
24. Tribal Coordination. Address Tribal Coordination if needed per section 4.8.



## **4.1.2 Scope of Work Report**

### **4.1.2.1 General**

The Scope of Work (SOW) Report identifies the major design features of the subject project, and provides an overview of the proposed project improvements. The project design will proceed as described in the Report unless opposition is expressed within the specified comment period. Any disagreement in the scope of the project must be resolved prior to the final approval by the Chief Engineer of the Engineering Division. Consequently, it is essential that the Scope of Work Report be written as soon as the appropriate data is available, but not before the environmental document is approved.

### **4.1.2.2 Preparation and Approval**

Use the following procedure to prepare the SOW Report and to obtain management approval of the Report:

1. Preliminary Draft. The Bridge Area Engineer will prepare the preliminary draft of the Report and all appropriate distribution memorandums. The Area Engineer will sign the Report and forward it to the Bridge Engineer through the Bridge Design Engineer.
2. Distribution. The Bridge Engineer will initial the distribution memorandum which requests concurrence from those on the distribution list. The distribution memorandum is a separate memorandum which is also prepared by the Bridge Area Engineer and submitted with the SOW Report. Figure 4.1C illustrates the format that should be used for distributing the Report to the appropriate individuals. Concurrence from FHWA is required for Interstate and other NHS projects. A copy

of the Scope of Work Report is submitted to FHWA for all other Federal-Aid projects.

3. Approval. Once concurrence has been received from those on the distribution list, the Bridge Area Engineer will prepare another memorandum requesting the Chief Engineer's, Engineering Division, approval for the SOW Report. Prepare this memorandum for the Bridge Engineer's signature. It should include the comments received and their proposed disposition. Figure 4.1D illustrates a sample memorandum used to request approval from the Administrator. After approval, copies of the SOW Report will typically be distributed to individuals listed in Figure 4.1D.

### **4.1.2.3 Format and Content**

In general, prepare the Scope of Work (SOW) Report in the sequence and format discussed below. This will provide a uniform presentation for all Department SOW Reports and will ensure that all necessary design elements are addressed. The level of coverage for each item may also vary from project to project. Although an in-depth discussion for each design element is usually not provided in this Report, provide sufficient detail to allow the reader to fully understand the proposed project.

The following provides the topic areas, in order, that should be addressed in the SOW Report:

1. Proposed Scope of Work. This section should provide a very brief description of the proposed scope of work for the project. For example, "The proposed project has been nominated to replace the existing 24 ft (7.2 m) bridge over the Madison River on US Highway 287 in Ennis. The new bridge will be constructed on a new alignment." The scope should indicate whether the project is a new structure, replacement structure or rehabilitated structure. The

scope of work section should also include a brief discussion explaining the reason why the proposed scope of work was selected.

2. Project Location and Limits. Some of the descriptions that may be used to briefly describe the project include:

- a. county name;
- b. city or town name;
- c. Indian reservation;
- d. route number;
- e. functional classification;
- f. reference points;
- g. project length;
- h. distances with respect to existing structures;
- i. crossing feature (e.g., river, highway, railroad) and name;



**Montana Department of Transportation**  
**PO Box 201001**  
**Helena, MT 59620-1001**

**Memorandum**

To: Distribution

From: (Name)  
 Bridge Engineer

Date: (Date signed by Bridge Engineer)

Subject: (FHWA Number)  
 (Location)  
 (Uniform Project Number)  
 (Project Work Type Number/See Figure 4.1B)

Attached is the **Scope of Work Report** for the subject project. Please review this report and submit your comments and concurrence by the **(Date)**. Your approval and recommendations are also requested if you do not concur or concur subject to certain conditions. When all the personnel on the **distribution** list have submitted their concurrence, this report will be submitted to the Administrator, Highways Division for final approval.

**Note: If you do not respond within two weeks we will assume your concurrence.**

(UPN-SOW)

**Distribution: /With Copies Attached, Note: Approvals Required**

District Administrator or Eng. Services Eng./Sup.	(e-mail and hard copy)
Administrator (Rail, Transit & Planning Div.)	
Administrator (Maintenance Div.)	I Recommend Approval
Highways Engineer	
Chief, Right of Way Bureau	_____
Chief, Environmental Bureau	
Preconstruction Engineer	Date: _____
Materials Engineer	
Construction Engineer	
Traffic and Safety Engineer	
FHWA/District Operations Engineer (for NHS)	

**cc: / With copies attached, Note: Comments welcome, approvals not required**

Chief Engineer, Engineering Div.	Geotechnical Engineer
Chief, Fiscal Programming Bureau	Road Design Engineer
Supervisor, Secondary Roads	Safety Management Engineer
Manager, Eng. Info. Services Section (EISS)	Bridge Management Engineer
Supervisor, Survey and Mapping Section	Supervisor, Utilities Section
Supervisor, Research & Development Section	County and/or Local Governments
FHWA, District Operations Engineer- (non-NHS)	Bridge File

**SCOPE OF WORK REPORT DISTRIBUTION MEMORANDUM**

**(Initial Report)**

Figure 4.1C



**Montana Department of Transportation**  
**PO Box 201001**  
**Helena, MT 59620-1001**

### Memorandum

To: (Name)  
 Chief Engineer, Highways and Engineering Division

From: (Name)  
 Bridge Engineer

Date: (Date of Bridge Engineer's signature)

Subject: (FHWA Number)  
 (Location)  
 (Uniform Project Number)  
 (Project Work Type Number)

Please find the Scope of Work Report for this project attached to this memorandum with approval or concurrence from (Distribution from Figure 4.1C).

We offer the attached responses to those comments.

(Attach list of comments and responses.)

With your approval we will proceed with the design to match the Scope of Work Report and the modifications from these comments.

Approved \_\_\_\_\_ Date \_\_\_\_\_  
 Chief Engineer, Highways and Engineering Division

**(UPN-SOW-APR)**

**Distribution: /With Attached Comments**

District Administrator	FHWA / District Operations Engineer
Eng. Service's Eng./Sup.	Chief, Right of Way Bureau
Administrator (Rail, Transit & Planning Div.)	Chief, Environmental Bureau
Administrator (Maintenance Div.)	Chief, Fiscal Programming Bureau
Chief Engineer, Engineering Div.	Manager, Eng. Info. Services Section (EISS)
Highways Engineer	Supervisor, Survey and Mapping Section
Preconstruction Engineer	Supervisor/Utilities Section
Materials Engineer	Supervisor, Research & Development Section
Construction Engineer	Supervisor, Secondary Roads
Traffic and Safety Engineer	County and/or Local Governments
Safety Management Engineer	Bridge File
Geotechnical Engineer	Bridge Management Engineer
Road Design Engineer	

### SCOPE OF WORK REPORT APPROVAL

Figure 4.1D

- j. crossing routes and/or streets;
- k. distance and direction from nearby cities and towns;
- l. as-built project numbers;
- m. adjacent project numbers; and
- n. direction of proposed project.

Whenever the stationing proceeds in the opposite direction from the reference points (e.g., stationing increases from north to south while the reference points increase from south to north), note this in the Report.

3. Physical Characteristics. A brief description of the project's physical characteristics may include a discussion of the following:
- a. year when the existing bridge and roadway were built, reconstructed or rehabilitated;
  - b. width, length and number of spans of existing structure;
  - c. approach roadway widths;
  - d. if available, the load capacity of the existing structure;
  - e. if available, sufficiency rating;
  - f. type of structure (e.g., prestressed concrete, structural steel); also list any special materials (e.g., timber, lead paint);
  - g. any structural deficiencies (e.g., joint failures, spalling, delamination);
  - h. rural or urban location;

- i. general description of the existing horizontal and vertical alignment; note all features which do not meet the Department's design criteria;
- j. vertical clearance of the structure;
- k. adequacy of waterway opening; where necessary, include a description of the major waterway features (e.g., width, location of bends, 100-year flood elevation); and
- l. any other unique physical characteristics related to the project.

4. Traffic Data. The traffic data in the Report should include the following:

- a. current AADT,
- b. letting date AADT,
- c. design year AADT,
- d. DHV,
- e. traffic distribution (D),
- f. number and percent of trucks (T), and
- g. the expected daily 18 kip (8165 kg) Equivalent Single Axle Loadings (ESAL), if paved.

5. Accident History. This section should briefly summarize the following accident history data:

- a. number of accidents;
- b. types of accidents;
- c. overall accident and severity rates for the project location;

- d. Statewide accident and severity rates for similar routes;
  - e. a description of how the project compares to the Statewide averages; and
  - f. if applicable, a brief description of why higher than normal number of accidents may be occurring and proposed counter-measures.
6. Major Design Features. The SOW Report should provide a general discussion for each of the following design features. This discussion should also include any approved design exceptions for that design element. Prepare each topic area based on the station sequencing. Although each major design element is provided its own section, the designer should address how the element will interact with other design elements. One or more of the topic areas may not be applicable to the project and need not be included in the Report. The SOW Report should discuss the following topics:
- a. Functional Classification. Note the functional classification of the highway (e.g., urban arterial, rural collector, rural local road).
  - b. Design Speed. This section should indicate the proposed design speed for the project. If more than one design speed is selected for the project (e.g., multiple bridges), then indicate the proposed design speed for each structure. For existing structures, also identify the existing posted speed limit.
  - c. Horizontal Alignment. Identify all major horizontal alignment features for the proposed project, including all features which do not meet the Department's design criteria. This includes the horizontal alignment for both the structure itself and for the approaches.
  - d. Vertical Alignment. Provide a description for all major vertical alignment features on the proposed project. This may include longitudinal grades, vertical curvature, vertical clearances and any elements which do not meet the Department's design criteria.
  - e. Bridge. Describe the proposed structure type and layout, if known. Note any special concerns that may significantly affect the cost of the bridge (e.g., seismic issues, scour, skewed crossings, special hydraulic features). Also address the removal of any existing structures.
  - f. Surfacing and Typical Sections. Provide a discussion on the proposed typical section of the project. This includes the overall structure width, approach width, number of travel lanes, travel lane widths, shoulder widths, sidewalks, type of bridge rail, etc. For the roadway approaches, indicate the proposed pavement design information including the pavement type and thickness, milling depths and widths, recycling considerations, etc.
  - g. Grading. Discuss the general grading of the project. This may include a discussion on need for special excavation, large amounts of borrow, special soil considerations, etc. Also describe any special proposed slope design for the project (e.g., steep side slopes, rock cuts, non-standard slope rates).
  - h. Geotechnical Considerations. This section should briefly identify the major

- geotechnical considerations and techniques that may be required to construct the project (e.g., soil types, slope stability options, special pier designs).
- i. **Hydraulics.** This section should provide a summary of the hydraulic features of the project (e.g., expected ice/debris problems, scour conditions, 100-year flood elevation, flood plain locations). Note any permits that will be required (e.g., Section 404).
  - j. **Traffic and Safety.** This section should include a brief discussion of Traffic and Safety features.
  - k. **Miscellaneous Features.** Provide a general discussion for all major design elements which are not identified in one of the above design areas. Miscellaneous features may include retaining walls, fencing, approach guardrail transitions, impact attenuators, any special traffic control devices (e.g., overhead signing on the structure), etc.
7. **Design Exceptions.** This section should identify any approved design exceptions for the project. The design exceptions should also be noted in the individual design areas in Comment #6.
  8. **Right-of-Way.** Briefly describe the existing and proposed right-of-way width requirements. Provide separate descriptions for each bridge on project. Document the amount of right-of-way acquisitions required, the type of right-of-way and any special features (e.g., taking of commercial property).
  9. **Utilities and Railroads.** The Report should describe any potential problems relative to utilities and/or railroads. The discussion should summarize any activities that have already occurred between the Department and the utility or railroad companies.
  10. **Environmental Considerations.** Summarize any environmental concerns identified in preliminary environmental documents. If the environmental document has been approved, include the date and conditions of approval. Also include brief descriptions of any environmental, cultural and/or hazardous waste site mitigation measures required.
  11. **Context Sensitive Design.** Summarize features in the design or impacts avoided due to Context Sensitive Design. Context Sensitive Design is project development that includes the physical surroundings and community along with safety/mobility and budget constraints. How does the road fit into the community? Highways should fit into their environment. Impacts should be minimized.
  12. **Stream Access.** Note existing stream access points and stream usage including existing fencing and parking in the vicinity of the project. Identify the stream's recreational value to the general public and any public or private access that will be affected by the project. Document approved enhancements or changes to the existing access conditions. Assess and document the right of way needs to maintain the existing access or to provide enhancements or other changes as agreed to with the Resource Agencies or private landowners. Note: Refer to Management Memo Number 02-01, Effective 03-01-02 for additional guidance.
  13. **Other Projects.** Discuss the resolution of any project conflicts identified in the Preliminary Field Review Report and determine if the projects can be combined for bid letting.

14. Traffic Control. Provide a discussion on the proposed traffic control strategy planned for the construction zone. This may include the need for detours, lane closures, traffic shifts, crossovers, etc.
15. Public Involvement. This section should summarize any concerns raised during the public involvement process and the proposed disposition. Note if and why a formal public hearing will be required.
16. Salvage. For county bridges, list the materials the county wishes to salvage.
17. Ready and Letting Date. Include the proposed letting date and ready date in the Report. The project ready date is typically three months prior to the letting date.
18. Cost Estimate. This section should provide the latest cost estimate available for the project. The designer may be required to prepare a detailed estimate for the Report. Separate the structure costs, roadway costs and removal costs. Add 10% for contingencies, then add 15% for construction engineering, and then 3% per year for inflation based on the total project cost.
19. Location Map. On some projects, it may be desirable to include a location map with the SOW Report.



### **4.1.3 Design Parameters Report**

#### **4.1.3.1 General**

The design parameters meeting is an internal review of the preliminary general layout sheet, boring logs and other necessary design documents to:

1. verify alignment and grade information from the Road Design Section;
2. review the proposed structure type;
3. discuss foundation types;
4. review the completeness of the preliminary general layout sheet;
5. compile a list of information to be provided to or required from other Bureaus;
6. finalize the general layout sheet prior to the plan-in-hand;
7. address any other special features (e.g., need for environmental documents, hydraulic concerns, environmental issues);
8. review the skew angle; and/or
9. review the bent and pier locations.

#### **4.1.3.2 Preparation**

The Bridge Area Engineer is responsible for scheduling the design parameters meeting. The design parameters meeting will, as appropriate, include the Bridge Engineer, the Bridge Design Engineer and representatives from:

1. Road Design Section,
2. Environmental Bureau,
3. Hydraulics Section,

4. Bridge Bureau,
5. Geotechnical Section,
6. Construction Bureau, and
7. other appropriate individuals.

The Design Parameters (DP) Report provides a written documentation of all decisions made during the review meeting. The Bridge Area Engineer is responsible for preparing the DP Report. Figure 4.1E illustrates the preferred heading and memorandum format that should be used when preparing the DP Report. Note that the DP Report is written to the project file. Copies of the DP Report will typically be distributed to the project file and those who attended the meeting. Items should be discussed with the District at the PIH.

#### **4.1.3.3 Format/Content**

When preparing the DP Report, consider the following:

1. Provide a separate section for each of the major topic areas discussed at the meeting.
2. If practical, identify all comments by station location. Also, include the distance from the proposed centerline.
3. State the proposed resolution to problems, questions or requests raised during the review meeting.
4. Where practical, identify the individual making the comment and who will resolve the comment.

A blank DP Work Sheet is provided at the end of this chapter. This Work Sheet provides a list of the typical items that should be addressed at a design parameter meeting.



Montana Department of Transportation  
PO Box 201001  
Helena, Montana 59620-1001

Memorandum

To: File

From: (Name)  
Bridge Area Engineer

Date: (Date signed by Bridge Area Engineer)

Subject: (FHWA)  
(Location)  
(Uniform Project Number)  
(Project Work Type Number)

On (date of meeting), a design parameters meeting was held to discuss the subject project. Those in attendance were:

(Attach Plans and Worksheet)  
(Distribution/Those in attendance only)

(Design Parameters Report)

**DESIGN PARAMETERS REPORT**  
**Figure 4.1E**

**Design Parameters Report**

*(Body of Report)*

**DESIGN PARAMETERS REPORT**

Figure 4.1E.1

#### **4.1.4 Bridge Type Selection Report**

##### **4.1.4.1 General**

The Bridge Type Selection Report is prepared by the consultant to identify potential structure alternates for a particular site. In this report, each viable structure type is evaluated in terms of initial and long-term costs, constructability, serviceability, and adaptability and fit to the site. Cost estimates are prepared for each alternative and a recommendation made for the preferred structure type.

##### **4.1.4.2 Preparation and Distribution**

The consultant prepares the Bridge Type Selection Report for the Consultant Design Engineer and the report is then distributed to the Bridge Engineer, District Administrator, Highways Design Engineer, and the Hydraulics Engineer with comments requested.

##### **4.1.4.3 Format/Content**

In general, the consultant will prepare the Bridge Type Selection Report in the sequence and format discussed below. All subject areas may not be required for each individual structure site. Sufficient detail should be provided so the reader can understand the selection process.

1. Introduction. Briefly describe the purpose of the report and the factors used in the selection of the preferred alternative.
2. Existing Structure. If the project involved is a bridge replacement, describe the existing structure. Indicate overall width and length, span lengths, skew angle, superstructure, substructure and foundation types. Also identify the existing vertical clearance if the bridge is located over a road or railroad.
3. Bridge Hydraulic Requirements. Indicate the flood frequency used for design, type of opening (vertical or sloped), channel bottom width, slope pitch, and freeboard requirements.
4. Proposed Location and Alignment. Indicate the new structure's alignment in relation to the existing alignment, if applicable. Mention if the horizontal alignment is located on a curve or tangent. Describe the vertical alignment (grades, vertical curve, crown, super transition).
5. Bridge Configuration. Describe the following features of the proposed structure and why selected:
  - Roadway Width
  - Sidewalk requirements
  - Structure Skew
  - Proposed End and Intermediate Bent Type
  - Bridge rail Type
  - Deck Geometry (crown, super, varying super)
  - Vertical clearance over highway or railroad
  - Deck Drainage
6. Right-of-Way. Identify if the proposed structure will require new right-of-way or construction permits.
7. Utilities. Identify if utilities are located on the existing structure and if they are to be accommodated on the new bridge. Describe how they are to be attached.
8. Structure Alternatives. List the structure types considered for the site. For each,

identify their particular positive and negative aspects based on the following:

- Construction ease
- Historic experience with
- Economics (initial and long term costs)
- Number of spans and bent placement
- Expansion joint and expansion shoe requirements
- Depth of section and freeboard or vertical clearance requirements
- Hydraulic performance (pier shape and alignment)
- Seismic performance category (if applicable)
- Maintenance costs

9. Recommendation. Identify a preferred alternate. Summarize the positive and negative features of the recommended configuration and the reasons for its selection. Include a preliminary General Layout in the report with a plan and elevation view of the proposed structure. Show the existing structure with foundation elements and their relationship to the new bridge.

#### **4.1.4 Plan-in-Hand Report**

##### **4.1.4.1 General**

A Bridge Plan-in-Hand (PIH) meeting is conducted in conjunction with the District to review preliminary construction plans that typically consist of road plans and cross sections and preliminary quantities. Preliminary bridge plans consisting of a bridge general layout and footing plan and cores. Right-of-Way plans are included when available. The PIH meeting typically consists of an office review followed by an onsite review.

The Bridge Area Engineer is responsible for scheduling the PIH, compiling and distributing the plans and other materials and writing and distributing the report. Include a copy of the Design Parameters report in the PIH distribution materials.

Include a copy of Design Parameters Report and the resolution of any outstanding issues from the Design Parameters Review Meeting.

The Plan-in-Hand (PIH) Report provides a written documentation of all decisions made during the Plan-in-Hand office and field review meetings. The PIH Report addresses the concerns and questions raised by the review team and their proposed disposition.

Refer to Figure 4.1F, 4.1F.1 and 4.1F.2.

##### **4.1.4.2 Preparation**

The Bridge Area Engineer is responsible for the preparation of the PIH Report. It is prepared for the Bridge Engineer's signature. Figure 4.1F illustrates the preferred heading and approval memorandum format when preparing the PIH Report. After the Bridge Engineer signs it, copies of the PIH Report will typically be distributed to the project file and to the following individuals:

1. all applicable Bureau Chiefs,
2. District Administrator,
3. Rail, Transit and Planning Division Administrator,
4. all parties involved in the PIH,
5. any other individuals or sections deemed appropriate, and

6. FHWA on NHS projects.

All parties receiving a copy of the PIH Report are requested to provide comments on the Report. Concurrence of the Report will be assumed if no comments are received by the specified date.

#### **4.1.4.3 Format and Content**

When preparing the PIH Report, consider the following:

1. Combine all office and field review comments into one Report.
2. Combine and present all comments from the office and field reviews in the order in which they appear in the plan sheets. Also present the comments for each sheet according to increasing stations down the proposed centerline of the project.
3. The first part of the PIH Report should provide all general comments on the project.
4. Identify all comments by sheet number and station location. If appropriate, provide the distance from the proposed centerline.
5. State the proposed resolution to problems, questions or requests raised during the review meeting.
6. Where practical, identify the individual making the comment.

**Montana Department of Transportation***PO Box 201001**Helena, Montana 59620-1001***Memorandum**

To: Distribution

From: (Name)  
Bridge Engineer

Date: (Date Signed by Bridge Engineer)

Subject: (Project Number)  
(Project Name)  
(Control Number)

A preliminary Road and Bridge PIH has been scheduled for this project for Tuesday, October 22, 2002. Attached are preliminary Road, Bridge and Right of Way plans. We will meet in the Great Falls District Construction Conference Room at 9:00 AM for a review of the plans. A trip to the site will follow the plan review if determined necessary. Come to the meeting prepared with your questions and comments related to the project. If you have comments but do not plan to attend send written comments to Area Engineer before the (date) meeting.

KMB: RWM:4235-PIH-Dist.

cc: Chief-Engineering  
Highways Engineer  
Administrator – Planning  
Supervisor – Environmental  
Preconstruction Engineer  
Materials Engineer  
Traffic and Safety Engineer  
Right of Way Engineer  
Road Design Engineer  
Bridge File

**Distribution:**

District Administrator: W/ 1 Set attached	Geotechnical Engineer: W/ 1 Set attached
Eng. Services Supervisor: W/ 1 Set attached	Environmental Engineer: W/ 1 Set attached
District Construction Engineer: W/ 2 Sets attached (1 set for FPM)	
Helena R/W: W/ 1 Set attached	Biologist: W/ 1 Set attached
Helena Utilities: W/ 1 Set attached	Road Area Engineer: W/1 Set attached
District Maintenance: W/ 1 Set attached	Hydraulics Engineer: W/ 1 Set attached
District Right-of-Way: W/ 1 Set attached	Bridge Design Manager: W/ 1 Set attached
District Utilities: W/ 1 Set attached	
District Design: W/ 1 Set attached	



Montana Department of Transportation  
PO Box 201001  
Helena, Montana 59620-1001

# Memorandum

To: Distribution

From: (Name)  
Bridge Engineer

Date: (Date signed by Bridge Engineer)

Subject: (Project Number)  
(Project Name)  
(Control Number)  
(Project Work Type)

We are requesting comments from the following individuals who have also received a copy of the Plan-in-Hand Report. We will assume their concurrence if no comments are received within two weeks of the approval date.

(Distribution List)

## **Distribution:** /With Attached Comments

District Administrator  
Eng. Service's Eng./Sup.  
Administrator (Rail, Transit & Planning Div.)  
Administrator (Maintenance Div.)  
Chief Engineer, Engineering Div.  
Highways Engineer  
Preconstruction Engineer  
Materials Engineer  
Construction Engineer  
Traffic and Safety Engineer  
Safety Management Engineer  
Geotechnical Engineer  
Road Design Engineer  
Bridge Management Engineer

FHWA / District Operations Engineer  
Chief, Right of Way Bureau  
Chief, Environmental Bureau  
Chief, Fiscal Programming Bureau  
Manager, Eng. Info. Services Section (EISS)  
Supervisor, Survey and Mapping Section  
Supervisor, Utilities Section  
Supervisor, Research & Development Section  
Supervisor, Secondary Roads  
County and/or Local Governments  
Bridge File

PLAN-IN-HAND MEMORANDUM

Figure 4.1F.1



**Plan-in-Hand Report**

The Plan-in-Hand review for the subject project was held...

*(Body of Report)*

PLAN-IN-HAND MEMORANDUM

Figure 4.1F.2

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## **4.2 CORRESPONDENCE**

### **4.2.1 In-House Memoranda**

#### **4.2.1.1 General**

Memoranda are used by MDT to provide written, interdepartmental information between the various Bureaus, Sections, Districts, etc. They are used to distribute project reports, process approval requests, request project information, submit project information, distribute policies and for informational purposes. Each Bureau and Section has established its own policies for circulating incoming mail. In general for the Bridge Bureau, the Bridge Engineer's staff will review incoming memoranda to determine the appropriate distribution.

#### **4.2.1.2 Format**

Prepare all memoranda in the standard format including the MDT Logo. This format is illustrated in the sample memoranda presented in Section 4.1 for project reports. The preparer should note that, for each project memorandum, fully complete the heading including the project number, project name and control number. Where applicable, also note the feature crossed, stationing and drawing number. For non-project reports, the subject should provide a brief but informative title of the memorandum's purpose.

#### **4.2.1.3 Signatures**

For outgoing memoranda, the Bridge Bureau has established the following signature requirements:

1. All memoranda containing substantive materials for distribution outside of the Bridge Bureau and for Bureau-wide general

information require the Bridge Engineer's signature.

2. Signatures for all other memoranda will be determined by the Bridge Area Engineer on a case-by-case basis. This includes general information distributed within the Bureau, general project correspondence, including those to the Districts, project information requests and other general day-to-day forms.

#### **4.2.1.4 Distribution**

The Bridge Bureau has established the following procedure for distribution of outgoing memoranda:

1. Project Information Submitted to Others. Memoranda providing project information to the Districts, other Bureaus or Sections should also include a copy to the following:
  - a. District Administrator, as needed;
  - b. author of memorandum;
  - c. the project file; and
  - d. others as needed.
2. Project Information Requests. Memoranda requesting project information from the Districts, other Bureaus or Sections should also include a copy to the following:
  - a. District Administrator, as needed;
  - b. author of memorandum;
  - c. the project file; and
  - d. others as needed.
3. District Correspondence. Address all correspondence to the Districts and to the District Administrator and include a copy of the following:
  - a. author of memorandum,
  - b. project file, and
  - c. emails that are indicated on examples
  - d. others as needed.

4. Other Information. Distribution and copies of other memoranda types will be determined on a case-by-case basis. In general, always include a copy to the Bridge Engineer.

#### **4.2.2 Outside Correspondence**

##### **4.2.2.1 General**

Prepare all written materials for sources outside of the Department on MDT letterhead. However, letters for the Governor's signature will be on Governor's letterhead.

When Department letters will often be written to individuals without a transportation background; use terminology which is understandable to the general public. In contrast, letters and surveys to AASHTO, FHWA, TRB, etc., should use standard highway engineering terminology.

##### **4.2.2.2 Signatures**

In general, all letters will be forwarded through the chain of command to the individual signing the correspondence. The following presents the Department's policy for signing all outgoing letters:

1. Letters to U.S. Congressmen, the Governor and legislators will be signed by the Director.
2. Letters responding to citizen inquiries will be signed by the Bridge Engineer or a higher level, depending on who initially received the letter.
3. Letters which provide information, including routine project information, to towns, counties or local officials should be signed by the Bridge Engineer.

4. Information requested by the news media should be signed by the Bridge Engineer or a higher level. General news releases may be signed by the Bridge Design Engineer or Bridge Management Engineer.
5. Information to Federal and State agencies, AASHTO, TRB, other State DOT's, etc., should be signed by the Bridge Engineer.
6. Project information submitted to consultants, contractors, suppliers, etc., should be signed by the Bridge Engineer.
7. In the absence of the Bridge Engineer, the Bridge Design Engineer or Bridge Management Engineer and Bridge Area Engineers have the authority to sign for the Bridge Engineer. However, the Bridge Engineer should have an opportunity to review the document before it is filed.

##### **4.2.2.3 Distribution**

Distribution of an outside letter will vary according to the information in the letter. A copy of all letters submitted outside of the Department should be sent to the Bridge Engineer. Copies of all letters signed by the Director of Transportation should be sent to the Montana Transportation Commission.

#### **4.2.3 Legislature and Media Contacts**

When contacted by news media, legislators, legislative audit staff, other government officials, etc., consider the following guidelines:

1. Responding. It is not the Department's policy to discourage employees from talking to reporters or officials. If the information is readily available, answer the question if you are comfortable doing so. If you are

uncomfortable about answering the question, forward it to the appropriate individual or your immediate supervisor.

2. Research. If answering the question will require additional research, determine the deadline. Try to accommodate the deadline unless it is unreasonable.
3. Supervisor. Inform your supervisor of the contact in a timely manner (e.g., the next day, later in the day). If trouble is suspected, immediately inform your supervisor of the contact.
4. News Media or Legislative Contacts. Report any news media or legislative contacts to the Public Affairs Bureau in the Central Office. For legislative contacts, complete the form in Figure 4.2A. Report any legislative audit contacts to the Administrative Division in the Central

Office. Refer these contacts in a timely manner unless trouble is suspected; if this is the case, contact the appropriate unit immediately. The purpose of reporting these contacts is to ensure the Central Office staff is aware of potential problems and/or to allow them to further address the problem.

5. Department Policies. Questions regarding Department policies should be left to administrators or higher level employees.
6. Controversial and Sensitive Issues. Refer inquiries on sensitive and controversial issues to the Public Affairs Bureau. This may include contacts which are uncomfortable to answer. In rare instances, employees will be asked to refer all calls on a specific issue to Public Affairs, as in the case of a pending legal issue or controversy that is receiving unusual attention.

<b>Legislative Contacts Report</b> Montana Department of Highways	
Legislator or other official: _____	Follow-up required? <input type="checkbox"/> Yes <input type="checkbox"/> No
Contacted: _____	
Date and time: _____	If so, due date: _____
Subject: _____ <i>Deliver this report to the Director's Office as soon as possible.</i>	
Summary of discussion: (use attachments, if necessary)	
Other comments:	
Prepared By: _____	

**LEGISLATIVE CONTACTS REPORT****Figure 4.2A**

### **4.3 MEETINGS**

Good communication is a necessity. It is imperative that all meetings be well planned, attended by the proper individuals, and the information disseminated to the affected people in a timely manner. The following provides additional information on various meetings conducted by the Bridge Bureau.

#### **4.3.1 Project Review Meetings**

During project design, there are typically several meetings to allow others to review the project design. MDT formal review meetings include the Preliminary Field Review, the Design Parameters Review and the Plan-in-Hand Review. In addition, informal meetings are often initiated to gather or disseminate information between the affected parties. When conducting the meetings, the following will apply:

1. Arranging the Meeting. The Bridge Area Engineer, or designee, will typically be responsible for arranging the meeting, determining the location and deciding who should attend the meeting. Schedule meetings at least two weeks in advance to allow individuals to arrange their schedules to attend the meeting.
2. Conducting the Meeting. Controversial meetings may be lead by the Bridge Engineer, Bridge Design Engineer or Bridge Management Engineer. Routine project meetings may be conducted by the Bridge Area Engineer.
3. Documentation. The Bridge Area Engineer, or designee, will be responsible for documenting the concerns and decisions made during the meeting. Section 4.1 provides the procedures for reporting the

results of major project meetings. For informal meetings, a memorandum documenting the decisions made during the meeting should be submitted to those involved with copies distributed to the project file and other individuals as deemed necessary. Complete the meeting documentation within 30 days after the meeting.

#### **4.3.2 Public Hearing**

A Public Hearing is a formal meeting conducted in accordance with Federal regulation. A public hearing is required on all projects requiring an environmental impact statement and on controversial projects. The purpose of the meeting is to educate the general public and to gather their comments on the proposed project. The Public Affairs Unit will be responsible for setting up and documenting the meeting. The District Administrator will be responsible for conducting the meeting. Bridge personnel may be asked to attend the public hearing to give specific details on the project and to answer questions relating to the bridge.

#### **4.3.3 Public Information Meeting**

Projects not requiring a public hearing, but requiring more than a news release, will typically require a public information meeting. This meeting is generally an informal meeting held to educate the general public and gather their opinions on the project. The Bridge Bureau may be asked to prepare information for the meeting. The District Administrator will typically be responsible for conducting this meeting. A report will typically be prepared by an individual determined prior to the meeting (e.g., District Administrator designee, Bridge Area Engineer).

**4.3.4 Staff Meetings**

Staff meetings are held to disseminate design and administrative information, discuss design problems, discuss policy changes and discuss personnel concerns. Staff meetings are held on an as-needed basis. These meetings may typically be attended by the Bridge Engineer, Bridge Design Engineer, Bridge Management Engineer, Bridge Area Engineers, and others as needed. The individual conducting the meeting will typically assign a designee to document the decisions and distribute them to all applicable parties.



## **4.4 PROJECT MANAGEMENT**

Project management is the application of resources, knowledge, skills, tools, and techniques to meet project requirements.

### **4.4.1 PMS System**

MDT uses a Project Management System (PMS) to schedule, forecast, monitor and coordinate project development and resources. Projects are broken down into defined activities with estimated duration and man-hours required for completion. Duration is the number of working days required to complete each activity. Activity durations are used to estimate the length of time to develop a project. Man-hours are the anticipated number of hours that will be expended toward the completion of the activity. Man-hours are used to estimate the cost and budget required to develop a project.

Each activity has predecessor and successor activities. Arranging the activities in order from predecessor to successor creates the project schedule or flow chart. A list of defined activities with standard flow charts for typical MDT projects have been developed by Engineering Information Services Section EISS.

MDT uses OPX2 software for PMS scheduling. For further information on OPX2 review the OPX2 Manual and consult EISS.

### **4.4.2 Bridge Bureau**

After a project is nominated and approved by the Highway Commission, EISS is initially responsible for inputting the project into OPX2 and for assigning standard man-hours and durations and a Design Project Manager (DPM). The DPM is responsible for reviewing the system information to assure it is correctly assigned based on the initial project nomination. The DPM will schedule and conduct a

Preliminary Field Review to better define the project scope. After the Preliminary Field Review Report is approved, transmitted to EISS, and placed in the Document Management System (DMS) the initial assumptions will be adjusted and the project will be sent out for overrides to the Functional Managers (FM) on OPX2 or turned over to Consultant Design. The override process is where FM's review the project and estimate durations and man-hours for their activities. If the DPM does not accept the overrides as returned he has the responsibility to negotiate with the FM in question until both DPM and FM agree to acceptable values.

### **4.4.3 Project Managers**

The Bridge Area Engineer, when acting as the Project Manager, will coordinate with EISS using the following process:

1. Store the completed Preliminary Field Review Report (PFR) on DMS.
2. Deliver the PFR with cover letter to EISS.
3. Along with EISS, review the project header information for accuracy. Project information includes project start date, engineer, flowchart, etc.
4. EISS will then set a start date and distribute the hard copies of the PFR according to the cover memo.
5. Log into the OPX2 browser application and release the project to the override process.
6. Send an email to the appropriate Functional Manager distribution list, informing them that the PFR is available on DMS and that the project has been sent out for overrides.

7. When the override process is completed, coordinate with EISS to set a ready date based on the override process.

The Project Manager is also responsible for:

1. Change in Scope. A major change in the project scope will likely result in the need for more or fewer project resources. The DPM will be responsible for initiating these changes in OPX2
2. Provide construction cost estimate updates to EISS, when necessary.

#### **4.4.4 Functional Managers**

1. The FM is responsible for estimating the duration and man-hours to complete their activities during the override process.
2. Update status of activities on OPX2 bi-weekly to keep project schedules current.
3. Notify the Project Manager of changes that will require additional resources or activities.

##### **4.4.4.1 Standard Planning Values**

Standard planning values for all activity durations and man-hours have been developed by EISS. These values are periodically reviewed and updated. To date, it has been difficult to track actual durations on past projects. Therefore, standard duration values are based on judgment. Durations are based on working days **not** calendar days. Standard man-hour values are determined by averaging actual man-hours spent to complete an activity over several projects. For activities that have highly variable durations and man-hours from project to project, standard planning values will not provide a very accurate estimate.

##### **4.4.4.2 Estimating Duration**

To estimate the duration of an activity consider the project scope, constraints, required man-hours, identified risks, historical data and standard planning value. The project scope indicates the level of complexity of a particular activity. An activity with higher complexity may increase the duration due to increased man-hours for completion, increased coordination efforts, or increased decision time. Duration constraints include elapsed time or production rate for the completion of activities. Example duration dependent on elapsed time is the activity "Approve Scope Of Work" that requires few man-hours but requires 3 to 4 weeks to provide time for comments and approvals. Example duration dependent on production rate is the activity "Prepare Bridge Superstructure Plans" that requires many man-hours. Production rates vary depending on how many people will be working on the activity, work that can be done concurrently and other competing priorities. Identified risks may include project delays, competing projects for resources, lower production rates, change in scope or poor estimate of man-hours. Presently, historical data for durations is difficult to retrieve but will be more readily available with OPX2. Standard planning values are provided in OPX2. These values provide a baseline of an "average project".

Duration may need to account for both elapse time and production rate. Standard planning values are typically close for activity durations that are dependent on elapsed time. Standard planning values of durations dependent on production rate should be adjusted based on the man-hour estimate.

Multiply an average production factor of 0.2 times man-hours to determine duration based on production. For example, the duration for 40

man-hours would be equal to 8 working days. The production factor assumes one person working on an activity with allowance for other tasks, vacation etc.

#### **4.4.4.3 Estimating Man-Hours**

To estimate the man-hours to complete an activity consider the project scope, identified risks, historical data and standard planning value. The project scope indicates the level of complexity of a particular activity. For example, will the bridge activity include a design of a single span prestressed girder or a multispan continuous steel plate girder? Identified risks may include context sensitive issues, resource agencies, railroad involvement, public involvement, environmental impacts and change in scope. A project with high risks may take more development hours. Historical data of actual hours spent on similar projects can be accessed on Oracle. Standard planning values are provided in OPX2. These values provide a baseline of an “average project”.

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## 4.5 MISCELLANEOUS PERSONNEL POLICIES

In addition to the policies presented in the **Montana Operations Manual**, the following sections provide additional guidance on several personnel policies.

### 4.5.1 Travel

The following will apply to traveling:

1. In-State. For travel within the State, prior approval must be obtained from the Bridge Area Engineer or higher administrator.
2. Out-of-State. For travel outside the State, present written justification to the Bridge Engineer for approval of the Chief Engineer, Engineering Division and Director. This justification should include the reasons for taking the trip and the expected cost of the trip.
3. Automobiles. Approval for use of State vehicles must be obtained from the Bridge Engineer, Bridge Design Engineer or Bridge Management Engineer.
4. Reimbursement. Per diem allowance and reimbursement requirements are listed in the **Montana Operations Manual**.

### 4.5.2 Alternative Work Shifts

Employees may work alternative work shifts. Under normal circumstances alternative work shifts would be any consistent combination of hours during a normal week (between work

hours 6:30 AM to 6:00 PM) that equals 40 hours per week. Once a shift is chosen it must be kept for a minimum of 3 months unless a situation arises for the employee that would preclude keeping those hours. Shift hours can be approved by the employee's immediate supervisor and need to be documented on employee roster kept by the Bureau Administrative Assistant. New employees are strongly encouraged to work shifts covered by more experienced employees so help can be obtained if needed.

The Bridge Engineer will approve maternity leave and other special situations in accordance with MDT Policy.

### 4.5.3 Leave Policy

Employees must contact their immediate supervisor prior to taking leave. The only exception would be in the case of an emergency. If the immediate supervisor cannot be contacted, then contact the next supervisor in line. Supervisors are required to ensure this policy is followed.

Note that the Department allows each employee to take one break, fifteen minutes long, in each of the morning and afternoon. The time is available as time to take a break during the work day, but Departmental policy does not allow using these break times to substitute for leave time. Time off work must come from annual leave, sick leave, or other approved leave types.

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#### **4.6 AGREEMENTS WITH OTHER STATE AND LOCAL ENTITIES**

The Department is responsible for design and construction for state, local and county owned bridge projects. These projects often require legal agreements to assure the expectations of all parties are met. Legal agreements typically used are for defining the maintenance responsibilities of the parties and for outlining ownership and transfer of liability for salvage items between the parties involved. The Design Project manager is responsible for drafting these agreements for review by the Bridge Engineer or Bridge Design Engineer.

Detailed directions and legal agreement templates exist on the MDT Intranet web site at: Departments\Engineering\Bridge\Documents\Agreements.

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## **4.7 CONSULTANT MONITORING**

### **4.7.1 Responsibilities**

#### **4.7.1.1 Consultant Design Bureau**

The Consultant Design Bureau is responsible for all administrative aspects of consultant-designed projects, including those under a term contract. This includes:

1. maintaining consultant prequalification lists;
2. advertising for consultant services;
3. preparing the Request for Proposals;
4. administering the consultant evaluation and selection process;
5. conducting contract negotiations with the selected consultant;
6. processing and executing the consultant contract;
7. processing consultant payments;
8. processing supplemental agreements;
9. monitoring project progress;
10. resolving disputes; and
11. closing out the contract.

For bridge issues, the Consultant Design Bureau is responsible for:

1. organizing and attending project field meetings required for the Preliminary Field Review Report and Alignment Review;
2. assisting the consultant, as necessary, to determine existing Right-of-Way limits, location of existing utilities, any

environmental concerns or other potential problems that could affect the scope of work;

3. reviewing content and format of consultant-prepared Preliminary Field Review, Alignment Review, Scope of Work, Design Parameters and Plan-in-Hand Reports;
4. submitting consultant-prepared reports to the Bridge Bureau for review and comment;
5. preparing all correspondence necessary for distribution and approval of reports, distribution of a news release and the request for preparation of the environmental document;
6. submitting preliminary, Plan-in-Hand and final plans to the Bridge Bureau for review and comment;
7. after review, returning reports or plans to consultant for correction; and
8. after acceptance by the Bridge Bureau, transmitting final plans to the Contract Plans Bureau.

#### **4.7.1.2 Bridge Bureau**

The applicable MDT engineering unit is responsible for coordinating with the Consultant Design Bureau on any technical aspects of consultant-designed projects. The Bridge Bureau is responsible for reviewing any bridge items within a consultant contract — either as part of an overall road design project or as a stand-alone bridge design project. The following summarizes the Bureau's responsibilities for consultant projects:

1. determining and justifying the need for consultant services;
2. determining the project scope of work;

3. evaluating and rating the consultants' proposals;
4. working with the consultant on an as-needed basis;
5. attending field meetings as required to provide input to the consultant for preparation of the Preliminary Field Review, Alignment Review, Scope of Work, Design Parameters Report and Plan-in-Hand Reports;
6. reviewing all work performed by the consultant for bid-ability, constructability, and conformance to Bridge Bureau standards and practice;
7. assisting the Consultant Design Bureau with performance and evaluation; and
8. in general, providing any needed technical support to the Consultant Design Bureau in the implementation of its administrative responsibilities.

#### **4.7.2 Project Implementation**

The following discusses the typical activities which occur during the implementation of a consultant-designed project.

##### **4.7.2.1 Scoping of Consultant Services**

A meeting will typically be held to identify a preliminary project scope of work for the consultant. This meeting will allow the Consultant Design Bureau to develop an appropriate Request for Proposals or to clarify the consultant's scope of work. A field review may or may not be required to determine the appropriate scope of work.

##### **4.7.2.2 Orientation Meeting**

The official Notice to Proceed provides the consultant with the authority to begin work on the project. However, before initiating the project work, it is desirable to hold a Scoping Meeting with the consultant, especially if the consultant is not familiar with Department procedures. The Meeting should be held as soon as possible after the Notice to Proceed is issued. This Meeting will be facilitated by the Consultant Design Bureau's Design Project Manager. The Meeting should be attended by a qualified representative of the Bridge Bureau and the District.

The objectives of the Orientation Meeting are to:

1. introduce the Department and consultant project team members to one another;
2. determine the lines of communication (e.g., clearly establish the principal contacts for both the Department and the consultant on technical and administrative issues);
3. review project objectives, critical design issues, and any Federal, State or local requirements that will impact the project;
4. review the Department's requirements for technical reviews, quality control, progress reporting and invoicing;
5. discuss the procedures for conflict resolution; and
6. review the consultant's detailed work plan and schedule.

#### 4.7.2.3 Project Schedule

To effectively monitor project progress, there must initially have been a clear definition of the project scope of work. Based on the scope, the consultant should have developed a realistic and detailed work plan and schedule to guide the project development process for both the Department and the consultant. With this initial schedule as a baseline, monthly progress can be monitored and compared with the baseline. Unforeseen circumstances will cause the progress to move ahead or fall behind the original plan, but routine delays that are often encountered should be anticipated with some slack built into the schedule to accommodate them.

The consultant should prepare a detailed schedule for the project, using the agreed upon contract dates for key events as the control points for the schedule. The schedule should clearly define activities and events to be performed by the Department and the consultant. If reviews by other MDT units or outside agencies are required, these should also be anticipated and scheduled. The schedule should be presented for review at the Scoping Meeting. This schedule will then be used to monitor project progress throughout project implementation.

If the MDT Design Project Manager and/or consultant determine that the project is behind schedule, the reason for the slippage should be determined. If the slippage is within the consultant's control, the Department should request in writing a plan from the consultant to return the project to the schedule. If the delay is the Department's responsibility or for circumstances beyond the consultant's control, MDT's Design Project Manager should determine what, if anything, can be done to expedite the project. If the schedule slippage is of sufficient magnitude that the contract completion date is not likely to be met, the

consultant should request a time extension with an explanation of the circumstances necessitating the extension.

#### 4.7.2.4 Monthly Progress Reports

The consultant will submit a written progress report at intervals as specified in the contract. Normally, progress reports are required for each month of the contract period, whether or not any progress has occurred. The progress report should be clearly identified as such and should contain:

1. Project Identification. Include Project Name, Project Number and Contract Number.
2. Reporting Period. Identify the month or period covered by the report.
3. Narrative Discussion of Project Status. Include the following:
  - a. discussion of work accomplished since the last progress report,
  - b. discussion of work planned to be accomplished before the next progress report, and
  - c. description of any major outstanding issues or concerns.
4. Percent Complete. Show percent complete by activity as labor expended and/or dollar value earned, depending on type of contract:
  - a. Lump-sum contracts — percent of dollar value earned by activity, and
  - b. Cost-plus contracts — percent of labor-hours expended by activity.

5. Project Schedule. State the status of the project progress relative to the approved Project Schedule.

Note that monthly progress reports must remain separate from other project reports; i.e., they should be submitted in a separate package to the Department.

#### **4.7.2.5 Department Reviews**

In general, the consultant is responsible for the accuracy and quality control of its work products. The Bridge Bureau will conduct reviews of the consultant's work as requested by the Consultant Design Section.

The **Montana Structures Manual** presents the Department's administrative and technical criteria for the development of bridge projects. The **Manual** has been prepared from the perspective of a MDT-designed project. However, all information in the **Manual** applies equally to consultant-designed projects, and consultants are expected to implement the project according to the Department's criteria.

The consultant will submit all work products to the Consultant Design Bureau, who will distribute it for review, evaluation and comment. In addition, the Design Project Manager will schedule, on an as-needed basis, periodic review meetings with the consultant. The objectives of the meetings may include answering Department questions, resolving Department comments, assessing project progress, etc. After the meeting, the consultant will be responsible for preparing minutes to document the key decisions made during the meeting.

#### **4.7.2.6 Scope-of-Work Changes**

When significant changes occur in the scope, character or complexity of the project work, a

Supplemental Agreement may be negotiated if it is mutually agreed that such changes are necessary. The consultant will document the revised scope of work and prepare a cost estimate for review and approval by the Department. If the change in scope is approved, a Supplemental Agreement will be processed by the Consultant Design Bureau.

No claim for extra work is acceptable before receipt of a duly executed Supplemental Agreement and notice to proceed.

#### **4.7.2.7 Final Acceptance of Work**

After the consultant has completed all work required by the contract, the consultant will submit a letter to the Department stating that the project work has been completed and requesting final acceptance of the work from the Department. If in agreement, the Consultant Design Bureau will prepare the Final Acceptance letter to the consultant with a copy to the Bridge Bureau. The letter will be signed by the Bridge Engineer.

#### **4.8 TRIBAL COORDINATION DURING PROJECT DEVELOPMENT.**

Coordination with the Tribal governments is an essential element of the project development process. In an effort to ensure that the Tribes are receiving the appropriate reports and documentation throughout the project development process, we are providing a checklist of documents and plans that should be sent to the Tribes.

The Design Project Managers will be responsible for sending this information to the Tribes. However, this should be verified with the District Administrator.

We also want to make sure that this information is getting to the right Tribal representatives. The contact people who typically receive these documents are listed below:

- Tribal Employment Rights Office (TERO) Director
- Planning Director  
(or Transportation Planner)
- Tribal President (or Chairman)

Once again this will probably vary with each Tribe. A list of the appropriate contact people should be obtained from the District Administrator or Chief of Environmental Services.

The information should be sent to each individual. Do not send it to one person and expect them to distribute it to the other Tribal representatives. We also recommend that documents be accompanied with cover letters that provide a more in-depth explanation of the information than is necessary for MDT personnel. For plans distributions it is not necessary to send plan to the Tribal Presidents. Sending them cover letters will be sufficient.

#### **4.8.1 Tribal Coordination Checklist**

##### **4.8.1.1 Preliminary Field Review:**

- Invitation to the field review
- PFR Report

##### **4.8.1.2 Alignment and Grade Review:**

- Invitation to the review accompanied by plans
- A & G Report

##### **4.8.1.3 Scope of Work Report:**

- Report distributed for comments (not signatory approval)
- Final Scope of Work Report with final approval

##### **4.8.1.4 Plan-in-Hand:**

- It may not be necessary to send the following information to the Tribes. The need will be determined on a project-by-project basis.
- PIH review invitation accompanied by Road plans, cost estimate, special provisions. (There has been some question about whether or not we should send the cost estimate to the Tribes. This issue should be resolved with the individual District Administrator.)
- PIH Review Report

##### **4.8.1.5 Final Plan Review:**

If a field review will be conducted, an invitation, plans and the report should be sent to the Tribes. If the FPR is just a distribution of plans for review, it will not be necessary to send anything to the Tribes.

**4.8.1.6 Blue Sheets:**

Contact the Contract Plans Bureau.

**4.8.1.7 Report and memo comments:**

These should be sent to the Tribes only if they affect previous decisions, are major changes or affect tribal property. The decision to send these memos should be made on a case-by-case basis and should generally be discussed with the District Administrator.

**4.8.2 ENVIRONMENTAL**

All environmental and resource information will be sent to the Tribes by the Environmental Services Bureau.

#### **4.9 BRIDGE WORKSHEETS AND CHECKLISTS**

In an effort to keep information consistent between District Design Teams we have developed checklists and forms to be used to gather data in the field, conduct meetings and request information. Examples of these forms are at the end of this chapter, but up to date versions are available on the Intranet.

The forms available are:

1. Preliminary Field Review Worksheet
2. Survey Request
3. Design Parameters Review

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## Chapter Five

# PLAN PREPARATION

Other chapters in the **Montana Structures Manual** provide the designer with uniform criteria and procedures for the design of structures. These designs must be incorporated into the plans so that they can be clearly understood by contractors, material suppliers, and Department personnel assigned to supervise and inspect the construction of the project. To ensure a consistent interpretation of the contract plans, individual sheets should have a standard format and content, and the sequence of plan assembly should generally be the same. To provide this consistency, this Chapter provides guidelines for the uniform preparation of structure plans including recommended plan sequence, drafting guidelines and plan sheet content. Refer to Standard Bridge Details and Notes [EREF.REF (MREF.REF)].

### 5.1 GENERAL INFORMATION

#### 5.1.1 Working Sheets

The Department currently uses the following paper sizes during project development:

1. 22 in. x 36 in. (D). Use this paper size for all final plans. Where deemed necessary, this size may also be used for preliminary design reviews (e.g., for complex drawings). Provide a minimum 2 in. left-binding margin and ½ in. top and bottom margins.
2. 11 in. x 17 in. (B). This paper size is the half-size of the “D” paper and is typically used for preliminary draft reviews, requests for permits and bid advertising. This plan

sheet is a half scale of the final plan size in Comment #1.

For the preliminary plans, print all sheets on white paper and use the “B” paper size. For final plans, consultants will submit stamped and signed size D mylars and updated electronic files. Full-size plans will be provided when requested. Transmit plans electronically to the Contract Plans Section. See the Bridge Internet site for the transmittal procedure. Full-size plans will be provided when requested.

#### 5.1.2 Construction Plan Sheet Organization

##### 5.1.2.1 Plan Sequence

To provide consistency from project to project, assemble the construction plan sheets in the sequence below. Note that not all plans will have all sheets and that several sheets can be combined together (e.g., Slab and Erection Sheets, Detail Sheets). If several sheets are combined, desirably the same sequence should be followed; i.e., they should be listed in order from left to right on the sheet. The recommended plan sequence is as follows:

1. Title Sheet and Quantities (Q) Sheet
2. General Layout of Structure Sheet
3. Footing Plan Sheet
4. PHASE construction sequence (when required)
5. Bent or Pier Sheet (by bent number)

- |                                     |   |
|-------------------------------------|---|
| 6. Erection Plan Sheet              | #1 and will have the following letter prefixes: |
| 7. Slab Detail Sheet                |   |
| 8. Beam or Girder Sheet             | a. Sanitary Sewer Plans — SS                    |
| 9. Detail Sheets (desirable order): | b. Water Plans — WS                             |
| a. Camber Sheet                     | c. Signing Plans — S                            |
| b. Splice Details Sheet             | d. Electrical Plans — E                         |
| c. Diaphragm Details Sheet          |   |
| d. Shoe and Joint Details Sheet     |   |
| e. Barrier Rail Sheet               |   |
| f. Standard Drawing Sheets          |   |

#### 5.1.2.2 Sheet Numbering

Bridge plans are typically included within a set of roadway plans. However, bridge plan sheets are numbered separately from road plans with a “B” prefix. Number all bridge plan sheets sequentially beginning with #1, and place the sheet number in the upper, right-hand corner of the sheet in the project information block. For other MDT units, the plan sheets will be numbered as follows:

1. Road Plans. Road plans are numbered with separate, sequential whole numbers (i.e., without a letter prefix). The project title sheet is considered as page one, but it is not numbered.
2. Cross Section Sheets. Cross section sheets are renumbered with a separate set of sequential whole numbers beginning with #1.
3. Other Units. Sanitary sewer, water, signing and electrical plans will be numbered separately within each group beginning with

## 5.2 GENERAL DRAFTING GUIDELINES

### 5.2.1 Drafting Procedures

The following provides general guidelines for the plotting of survey data and design details on the plan sheets:

1. Abbreviations. Wherever practical, avoid using abbreviations. Figure 5.2A presents common abbreviations that should be used where it is necessary to abbreviate elements within the set of plans. Do not use abbreviations in titles of details or in title blocks.
2. Standard Notes. These notes are consistent from project to project and can be found in the Department's **Standard Bridge Details and Notes** publication. If these notes are revised on a specific project, the plans must indicate that the standard note has been changed by removing the "standard" stamp prior to sending the plans to a checker.
3. Scales. Desirably, most drawings or details should be drawn to scale. The scales used on a set of plans will vary from sheet to sheet and may vary from detail to detail within a sheet. In general, scales should be large enough to clearly show all dimensions and details necessary for construction of the structure and yet allow the detail or view to fit on a sheet. Figure 5.3C and Section 5.4 provide further guidance on the selection of scales for the various plan sheets.
4. Overcrowding. Avoid overcrowding a sheet. If all the details that normally appear on a particular sheet will result in overcrowding, use an additional sheet. If a corresponding view or a section is placed on another sheet, clearly cross reference both sheets.
5. Duplication. Only show a detail once within a set of plans. If required on another sheet, cross reference the detail.
6. Stationing. MDT uses 100 ft. (100 m) stations. Stationing is shown in the plans to the one hundredth of a foot or thousandth of a meter.
7. Dimensioning. Ensure that sufficient dimensions are given in the plans. Dimension so that the reader need not add or subtract dimensions to determine the length, width or height of an element. When preparing plan dimensions, consider the following:
  - a. English Units. All dimensions are to 1/16 in. All elevations are to 0.01 ft. Do not show the tick marks when dimension in feet and inches (0-6). Include the tick marks when dimensioning only in inches (6").
  - b. Metric Units. For the General Layout and span length and overall length on Footing Sheets, most dimensions will be measured to 0.001 m. For footing sheets, show all details in millimeters except span lengths and overall length. Label the lengths with the meter symbol. (72.000 m  $\nless C$  Brg. To  $\nless C$  Brg. Of End Bents.) For all other sheets, show all dimensions in millimeters (mm), except for elevations which are in meters (m). Do not include the m or mm symbols in the dimensions on the plan sheet unless it is part of a description (e.g., 19-mm stud). Where noted, the m or mm units are shown in lower case.
  - c. Span and Structure Lengths. To determine structure and span lengths, see Section 12.4 for guidance on using the State Plane Coordinate System.

- d. **Repetitive Dimensions.** Duplicate dimensions may create problems if a dimension is changed on one detail and not another. If duplicate dimensioning is used, ensure that it is consistent from one detail to another.
  - e. **Location.** Preferably, dimensioning should be written horizontally or so that it can be read from the right. If practical, place the dimension above or to the right of a detail.
8. **North Arrow.** Place a North arrow on the General Layout and Footing Plan Sheets and on any plan sheets where its orientation is necessary. For uniformity within a set of plans, use one of the standard North arrow CADD cells.
  9. **Title Block.** A title block will be placed in the bottom, right-hand corner of every sheet, except the Quantities (Q) Sheet. Place the following information, in order, in the title block:
    - a. the Department MDT logo;
    - b. the feature crossed and/or location of structure;
    - c. the station location (note that the station location is the mid-station between the beginning and end bearing stations);
    - d. the Federal-aid project number;
    - e. the county name, underlined;
    - f. the sheet name;
    - g. the project phase, if applicable;
    - h. the major scale used on the sheet;
    - i. CADD file name; and
    - j. drawing number.
  10. **Project Information Block.** All sheets will have a standard block in the upper, right-hand corner indicating "Federal-Aid" project number and sheet number.
  11. **Drawing Numbers.** Drawing numbers are shown in the bottom of the Title Block. Each sheet is assigned a separate drawing number during the plan checking stage. Bridge plan sheets are consecutively numbered within a project. The Bridge Design Engineer maintains a register of assigned drawing numbers. This register contains information on project numbers, project designations and drawing numbers used. Original drawings are filed according to the drawing number. As-built sheets are not assigned additional drawing numbers. Q and General Layout Sheets have the same drawing number. However, the Q sheet number has a "Q" suffix.
  12. **Consultant Projects.** The consultant's name may appear above or to the left side of the title block or up near the upper, right-hand corner of the sheet. Each sheet should be reviewed and initialed and sealed by a licensed engineer before the plans are submitted to the Department.

About		Abt.	Liter	L
Abutment		Abut.	Left	Lt.
Alternate		Alt.	Longitudinal	Longit.
American Associate of State Highway and Transportation Officials		AASHTO	Maximum	Max.
American Society for Testing Materials		ASTM	Meter	m
And		&	Metric Ton	MT
Approximate		Approx.	Millimeter	mm
At		@	Minimum	Min.
Average		Avg.	Miscellaneous	Misc.
Bearing	Brg.		Near Face	N.F.
Board		Bd.	Northbound	N.B.
			Number	No.
			Outside Diameter	O.D.
Celsius		°C		
Center		Ctr.	Paving Notch	P.N.
Centerline		☎	Percent	%
Center of Gravity		C.G.	Plate	Pl.
Center to Center		C to C	Point	PT.
Clearance		Cl.	Pound	Lb.
Cubic		Cu.	Present Traveled Way	P.T.W.
Degree		°	Radius	R.
Diameter		Dia.	Reinforced Concrete Bar	R.C.B.
Diaphragm		Diaph.	Reinforced Concrete Pipe	R.C.P.
Dimension		Dim.	Reinforced Concrete Pipe Arch	R.C.P.A.
Drawing		Dwg.	Reinforcement	Reinf.
			Right	Rt.
Each	Ea.		Right of Way	R/W
Eastbound		E.B.	Roadway	Rdwy.
Elevation		Elev.		
Embedment		Embed.		
Equal		=	Southbound	S.B.
Expansion		Exp.	Spaces	Spa.
			Square	Sq.
Fahrenheit		F	Standard	Std.
Feet or Foot	Ft. (')		Station	Sta.
Fill Face		F.F.	Steel	Stl.
Fixed		Fix.	Superelevation	Super.
Galvanize		Galv.	Tangent	Tan.
Galvanized Iron	G.I.		Topographic	Topog.
Gauge		Ga.	Typical	Typ.
Grade		Gr.		
			U.S. Geological Survey	USGS
Hexagon		Hex.		
High Water		H.W.	Vertical	Vert.
			Vertical Curve	V.C.
Inch	In. (")			
Inside Diameter	I.D.		Westbound	W.B.
Interior or Intermediate		Int.		
			Yard	Yd.
Kilogram		kg		
Kilometer		km		

**STANDARD ABBREVIATIONS****Figure 5.2A**

### **5.2.2 Plotting Survey Data**

For surveys conducted by aerial survey, the Photogrammetry and Survey Section will be responsible for plotting the survey data. For data collector surveys, the information will be submitted in a MicroStation design file with a FLD extension. The road designer and surveyor will coordinate to finalize the FLD file and create the Digital Terrain Model file. The surveyor and road designer will place the file on the network and will notify the appropriate personnel that the survey information is available. For manually conducted surveys, the road designer or consultant will be responsible for plotting the survey data using the Department or approved compatible CADD system. In addition to the field notes, the road designer should obtain a copy of the as-built plans (if available) for informational purposes. The as-built plans can be obtained at the MDT headquarters.

The **MDT Survey Manual** provides the Department's criteria for plotting the survey field notes. For project surveys, an established point is typically assigned a set of coordinate values, and the coordinates for all other points are calculated from these assumed values. Global Positioning System (GPS) surveys utilize the NAD 83 State Plane Coordinate Systems; for additional information, see Chapter 12.

### **5.3 CADD DRAFTING**

Project drafting will typically be performed on CADD. To help in providing consistency from project-to-project and among designers, the following sections provide Department guidelines for the CADD drafting of construction plan sheets.

#### **5.3.1 CADD Software**

MDT has selected MicroStation as its Department-wide computer-aided drafting and design software package. The following sections provide the Department's CADD criteria for plan development (e.g., cell libraries, levels, text sizes, fonts). Using MicroStation's levels and reference files allows various users within the Department to work on the same set of plans without interfering with each other's design work (e.g., Right-of-Way, Electrical). By integrating or linking MicroStation with other software packages (e.g., GEOPAK, databases), the designer can use the computer to perform the actual design and layout of a project.

MicroStation is a complex program with many features. If problems or questions occur when using the software, the user should first contact a lead CADD operator.

All users outside of the Department network should consult with the MDT CADD Coordinator to determine which version(s) of the software programs are acceptable to the Department. All consultants submitting CADD contract plans to the Department must use the same version as the Department.

#### **5.3.2 File Setup**

Each project is saved in its own subdirectory on the Department's central computer. The project subdirectory is named using the 7 or 8 digit

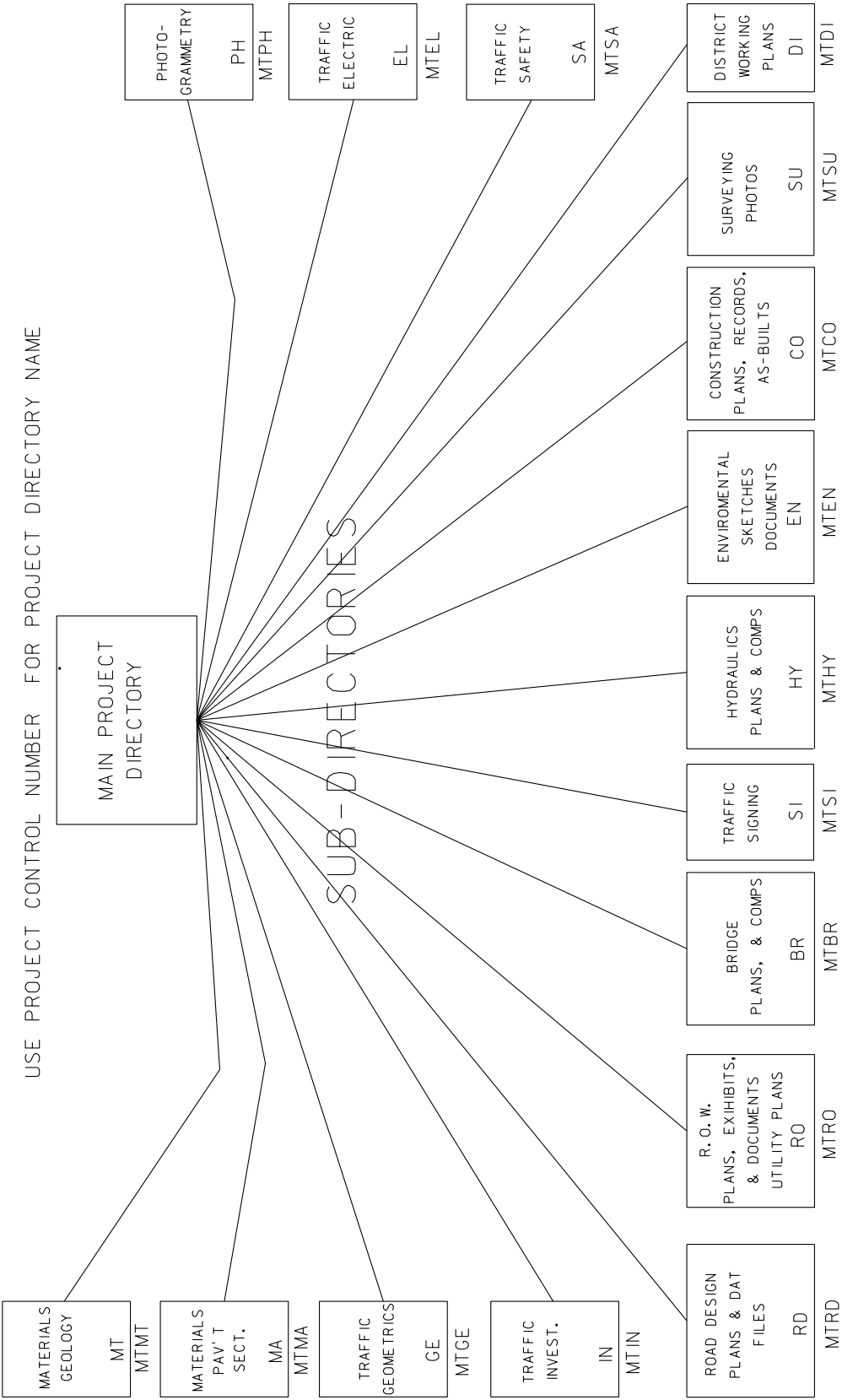
uniform project number. Uniform project numbers are provided by the Engineering Management Unit. Subdirectories are provided for each of the Department units involved with the project (e.g., Bridge, Road, Right-of-Way, Survey) under the project directory. Figure 5.3A provides the subdirectories that will be used for each of these Department units.

Individual user files are saved within each of the unit's subdirectory. To allow others to determine the content of files without reviewing them, files should be named using the guidelines set in the MDT CADD Standards document.

When setting up a file, the designer should use the standard seed file as stated in the MDT CADD Standards document to ensure that the proper coordinate system is used. The Department also uses a standard file format for the placement of individual plan sheets in the files. For more information on these formats, see the **MDT CADD Standards** or contact a lead CADD operator.

#### **5.3.3 Reference Files**

Reference files allow the various users to integrate several files together from several sources and to view the result from all the files in one view. The project strip map is an example of a reference file that is used by various designers to develop the project (e.g., Right-of-Way, Traffic, Road Design, Hydraulics). Reference files allow the designers to see how their design will interact with the various other unit designs. Although reference files allow designers to review other units' files, the designer is unable to make changes to these other files. The designers can only make changes to their own files. It should be noted that, where appropriate, designers can copy elements from the reference file to their own file. Detach External reference files after copying elements.



1. Anyone can reference a file from any subdirectory with in the project directory using the logical name listed below the sub-directory box.
2. Other reference file logical names are MTSTD, MTBRSTD, MTRDSTD, MTGESTD, MTELSTD, MTSISTD, and MTSASTD.

PROJECT SUBDIRECTOIRES

Figure 5.3A



Over the years we have added several symbols to Fonts 15 & 16.  
Listed below is a list of these symbols

Key Stroke	Symbol	Example	
		Font 15	Font 16
^	Degree	$\text{  }^\circ$	$/\ /\circ$
!	Plus/Minus	$\pm$	$\pm$
{	Sub S	$\text{  }_s$	$/\ /\sub s$
}	Sub C	$\text{  }_c$	$/\ /\sub c$
[	Square (2)	$\text{  }^2$	$/\ /\sup 2$
]	Cube	$\text{  }^3$	$/\ /\sup 3$
<	Theta	$\Theta$	$\theta$
>	Delta	$\Delta$	$\Delta$
\127	Diameter		$\varnothing$
\128	Plate		$\overline{\text{L}}$
	Center line	$\text{C}\overline{\text{L}}$	$\text{C}\overline{\text{L}}$

**Figure 5.3B**  
**Standard Font added symbols for**

For more information on reference files, the designer should review the **MDT CADD Standards** or contact a lead CADD operator.

#### **5.3.4 Cell Libraries**

Cell libraries have been developed to allow the CADD user to call up a symbol, figure, form, etc., without the need to redraw it each time. To obtain a copy of these cell libraries, MDT employees should contact a lead CADD operator. Outside consultants should request a copy of the cell libraries from the Consultant Design Section or download them from the Department's Internet web site.

#### **5.3.5 Text Sizes**

Figure 5.3C illustrates the text sizes that should be used based on the selected drafting scale. Use of these text sizes will ensure the text size will be shown correctly when it is referenced into the main file.

#### **5.3.6 Drafting Symbols**

For plan consistency, the Department has developed a set of symbols that should always be used to indicate certain elements. For symbol uniformity and ease of drafting, these symbols have been incorporated into the Department's

Font libraries. Figure 5.3B illustrates several of these symbols.

#### **5.3.7 Drafting Levels**

MicroStation allows the user to select different levels to input the figure data. Follow the Bridge Bureau guidelines as shown in the **MDT CADD Standards**.

Because units other than the Bridge Bureau may utilize the information contained on the various levels, placement of data on the correct level is essential. Presenting the project data on different levels allows the user to see or print only the desired data by turning on or off the various levels. Data from other levels will not be shown.

#### **5.3.8 Annotation Guidelines**

To provide uniformity from sheet to sheet, see the **MDT CADD Standards** for annotation guidelines that should be used on the Title and Q Sheet and for the other drawing sheets.

ENGLISH SCALES					
Scale	Full to Scaled Ratio	Scaled to Full Ratio	Text Height When Full Scale		
			Text	Titles	LS =
1" = 1"	1	1	1/8"	3/16 "	5/64"
3" = 1' - 0"	0.25	4	1/2 "	3/4 "	19/64 "
1 1/2" = 1' - 0"	0.125	8	1"	1 1/2 "	19/32 "
1" = 1' - 0"	0.80	12	1 1/2"	2 1/4 "	29/32 "
3/4" = 1' - 0"	0.0625	16	2"	3"	1 13/64 "
1/2" = 1' - 0"	0.0417	24	3"	4 1/2"	1 51/64"
3/8" = 1' - 0"	0.0313	32	4"	6"	2 13/32"
1/4" = 1' - 0"	0.0208	48	6"	9"	3 19/32"
3/16" = 1' - 0"	0.0156	64	8"	1' - 0"	4 51/64"
1/8" = 1' - 0"	0.104	96	1' - 0"	1' - 6"	7 13/64"
3/32" = 1' - 0"	0.0078125	128	1' - 4"	2' - 0"	9 19/32"
1" = 10' - 0"	0.00833	120	1' - 3"	1' - 10 1/2 "	9"
1" = 15' - 0"	0.0056	180	1' - 10 1/2 "	2' - 9"	1' - 1 1/2 "
1" = 20' - 0"	0.0042	240	2' - 6"	3' - 9"	1' - 6"
1" = 30' - 0"	0.0028	360	3' - 9"	5' - 7 1/2 "	2' - 3"
1" = 40' - 0"	0.0021	480	5' - 0"	7' - 6"	3' - 0"
1" = 50' - 0"	0.0017	600	6' - 3"	9' - 4 1/2"	3' - 9"
1" = 60' - 0"	0.0014	720	7' - 6"	11' - 3"	4' - 6"

## ENGLISH TEXT SIZES

Figure 5.3C.1

METRIC SCALES					
Scale	Full to Scaled Ratio	Scaled to Full Ratio	Text Height When Full Scale		
			Text	Titles	LS =
1:1	1	1	3 mm	5 mm	2 mm
1:2	0.50	2	6 mm	10 mm	4 mm
1:3	0.334	3	9 mm	15 mm	6 mm
1:5	0.20	5	15 mm	25 mm	10 mm
1:10	0.10	10	30 mm	50 mm	20 mm
1:15	0.0667	15	45 mm	75 mm	30 mm
1:20	0.05	20	60 mm	100 mm	40 mm
1:25	0.04	25	75 mm	125 mm	50 mm
1:30	0.0334	30	90 mm	150 mm	60 mm
1:40	0.025	40	120 mm	200 mm	80 mm
1:50	0.02	50	150 mm	250 mm	100 mm
1:100	0.01	100	300 mm	500 mm	200 mm
1:150	0.0067	150	450 mm	750 mm	300 mm
1:200	0.005	200	600 mm	1000 mm	400 mm
1:250	0.004	250	750 mm	1250 mm	500 mm
1:300	0.00334	300	900 mm	1500 mm	600 mm
1:400	0.0025	400	1200 mm	2000 mm	800 mm
1:500	0.002	500	1500 mm	2500 mm	1000 mm
1:1000	0.001	1000	3000 mm	5000 mm	2000 mm

## METRIC TEXT SIZES

**Figure 5.3C.2**

## 5.4 PLAN SHEET CONTENT

The following sections provide guidance on the layout and information that should be included on each sheet within a set of bridge plans. See **Standard Bridge Details and Notes** for further guidance. The designer should note that not all elements discussed for the various sheets will be required on every sheet. Also note that if the information does not fit on one sheet, it may be placed on a second sheet or added to another sheet.

### 5.4.1 Title Sheet and Q Sheet

The Title Sheet and Q Sheet is the front cover for a set of bridge plans. It identifies the project information, list of bridge drawings and estimated bridge plan quantities. This information is discussed in the following sections.

#### 5.4.1.1 Title Information

Show the project title information in the top center of the sheet and in the following order:

1. Montana Department of Transportation.
2. Three separation lines.
3. Text "BRIDGE PLANS & QUANTITIES."
4. Project Preliminary Engineering (PE) and construction numbers (CN) as provided by the Fiscal Programming Section. Figure 5.4A defines the project number codes.
5. Project descriptions as provided in the Engineering Management System Report. These are typically the name of the river or railroad crossed and its location (e.g., city, town), interchange name, etc.

6. County name, underlined.

#### 5.4.1.2 List of Drawings

In the middle of the Q Sheet, provide a table of contents listing each design drawing and Standard drawing included within the set of bridge plans. Format the table of contents as follows:

1. Title. Use the title "List of Drawings" and underline the title.
2. Contents. Below the title include three columns for the following:
  - a. Sheet No. Section 5.1.2.2 provides the criteria for numbering sheets.
  - b. Drawing No. Section 5.2.1 provides guidance for determining the applicable drawing number.
  - c. Description. The description will consist of the sheet title and, for the General Layout Sheet, the station of the structure.
  - d. Standard Drawings. For each Standard Drawing, include the approval or revision date of the drawing.
3. Multiple Structures. If there are multiple structures on the project, provide a separate list of drawings for each structure. Center the lists horizontally across the sheet. List the standard drawings for all of the bridges at the end of the list.

#### 5.4.1.3 Estimated Bridge Plan Quantities

Include a quantities table for the bid items found within the bridge plans and center the table

horizontally at the bottom of the sheet. Prepare the quantities table in the following manner:

4. Location. Include Bridge ID Number.
5. Segregation. Segregate the quantities according to the following:
  - a. Segregate the quantities for each bent and the superstructure. First list the bents in order of increasing stations and then the superstructure.
  - b. Where two or more structures are provided, also segregate the quantities for each structure in the same manner as described in Comment a. Provide a subtotal for each structure. List the structures in order of increasing stations.
  - c. Where more than one phase is used to construct the structure, segregate the quantities for each phase. Provide a subtotal for each phase.
  - d. Segregate Quantities for on-off reservation and crossing county lines.
6. Quantities. Only use the pay items and units provided in the **MDT Standard Specifications** or special provisions. Where practical, list the pay items, from left to right on the sheet, in the order presented in Figure 6.1A. Figure 6.1A also lists the rounding criteria that should be used in the table. Enter the numbers on the left side of the column to leave room for the as-built quantities to be entered later.
7. Length. The measured bridge length is the stationing distance measured from the centerline of bearing to centerline of bearing and rounded to a tenth of a foot (.1 ft) (hundredth of a meter (i.e. .01 m)). See Section 12.4 for measuring the length using the State Plane Coordinate System.

8. Total. Provide a total for all structures and phases at the bottom of the table. Note that for lump sum items the total quantity will always equal 1. Individual structures or phases will be a percentage of the total amount based on the quantity or length of the item. For more information on lump sum items, see Sections 6.2 and 7.2.

#### 5.4.2 General Layout of Structure Sheet

The General Layout Sheet illustrates the basic layout of the structure with respect to the natural ground. The following lists the basic information that should be included on a General Layout Sheet. Wherever practical, the General Layout Sheet should be contained on one sheet.

##### 5.4.2.1 Plan View

Place the Plan View of the structure in the upper, left-hand corner of the sheet. Consider the following guidelines when preparing the Plan View:

1. Scales. Use the largest scale practical that will allow the Plan View of the bridge to fit between the left edge of the sheet and the notes on the right-hand side of the sheet. Figure 5.3C lists the scales commonly used on bridge plans. Select a scale that effectively uses the drawing sheet.
2. Structure. Show the outline of the new structure with solid dark lines. Show existing structures with lighter dashed lines. Include a note to the disposition of the existing structure (e.g., remove existing structure).
3. Contours. In general, show contour lines in 1 ft. (0.5 m) intervals. Label 5 ft. (2 m)

intervals and use line weight and levels according to CADD standards.

4. Stationing. In general, draw the structure so that the stationing is increasing left to right on the sheet. Note the stationing:

Project NH1-9(23)565

NH-Funding Designation (see table below)

1 - Route Number

9 - County Designation along the route (west to east, south to north)

23 - Agreement Number

565 - Reference Point on the Route



- a. at the end of the paving notch for each end bent,
- b. at the end of the bridge rail or barrier for each side, and
- c. at the intersection of the design centerline with the crossroad or railroad design centerline. If a railroad is involved, show the railroad stationing.

Figure 5.4B illustrates the criteria for

### PROJECT CODE DEFINITIONS

Federal-Aid Program	Project Prefix
Interstate Program: Interstate - Maintenance	IM
National Highway System: National Highway	NH
Surface Transportation Program: Secondary Urban Primary (minor arterial) State Flexible (State Highway) Rail/HWY Crossing - Hazard Elimination Rail/HWY Crossing - Protective Devices Hazard Elimination Transportation Enhancements	STPS M, STPU STPP STPX STPRR STPRP STPHS STPE
Bridge Program: Bridge Replacement & Rehabilitation - 65% (On-System) Bridge Replacement & Rehabilitation - 15% (Off-System) Bridge Replacement & Rehabilitation - 20% (Either)	BR & BH BR & BH BR & BH
Congestion Mitigation & Air Quality Improvement Program: Congestion Mitigation & Air Quality	CM
SPR/PL Program: HWY Planning & Research Research, Development & Technology Transfer Metropolitan Planning	SPR SPR PL
Innovation Projects: DPI Projects	DPI
Demonstration Projects	HDP
Discretionary Funds: Public Lands	PLH
Forest Highway	FH
State-Aid Program	Project Prefix
National Highway System: National Highway (Non-Interstate)	RTF
State Primary	RTF
State Secondary	RTS
State Urban	RTM
State Highway (State maintained)	RT

Figure 5.4A

determining station locations at the end of the structure.

5. Dimensions. Dimensions on the Plan View may include:

- a. the overall width of the structure;
- b. barrier and railing widths;
- c. width between the face of the barrier or to the design centerline of the bridge (see Figure 5.4C);
- d. traveled way widths;
- e. horizontal distance between design center-lines for dual structures;
- f. median widths;
- g. offset width between the roadway design centerline and the structure centerline;
- h. width of each phase, for phased projects;
- i. outside dimensions of slope protection;
- j. length of each barrier rail on the structure from centerline of end bearing to centerline of end bearing at the edge of the slab and the total pay length, see Figure 5.4B;
- k. the distance the barrier rail extends beyond the end bearings; and/or
- l. on curved bridges, the span chords, long chords and bearings lengths.

6. Bridge Rail. On the bridge rail dimension, note the type of rail proposed after the length (e.g., Type T101, pedestrian rail, combination rail). For T101 railing, also

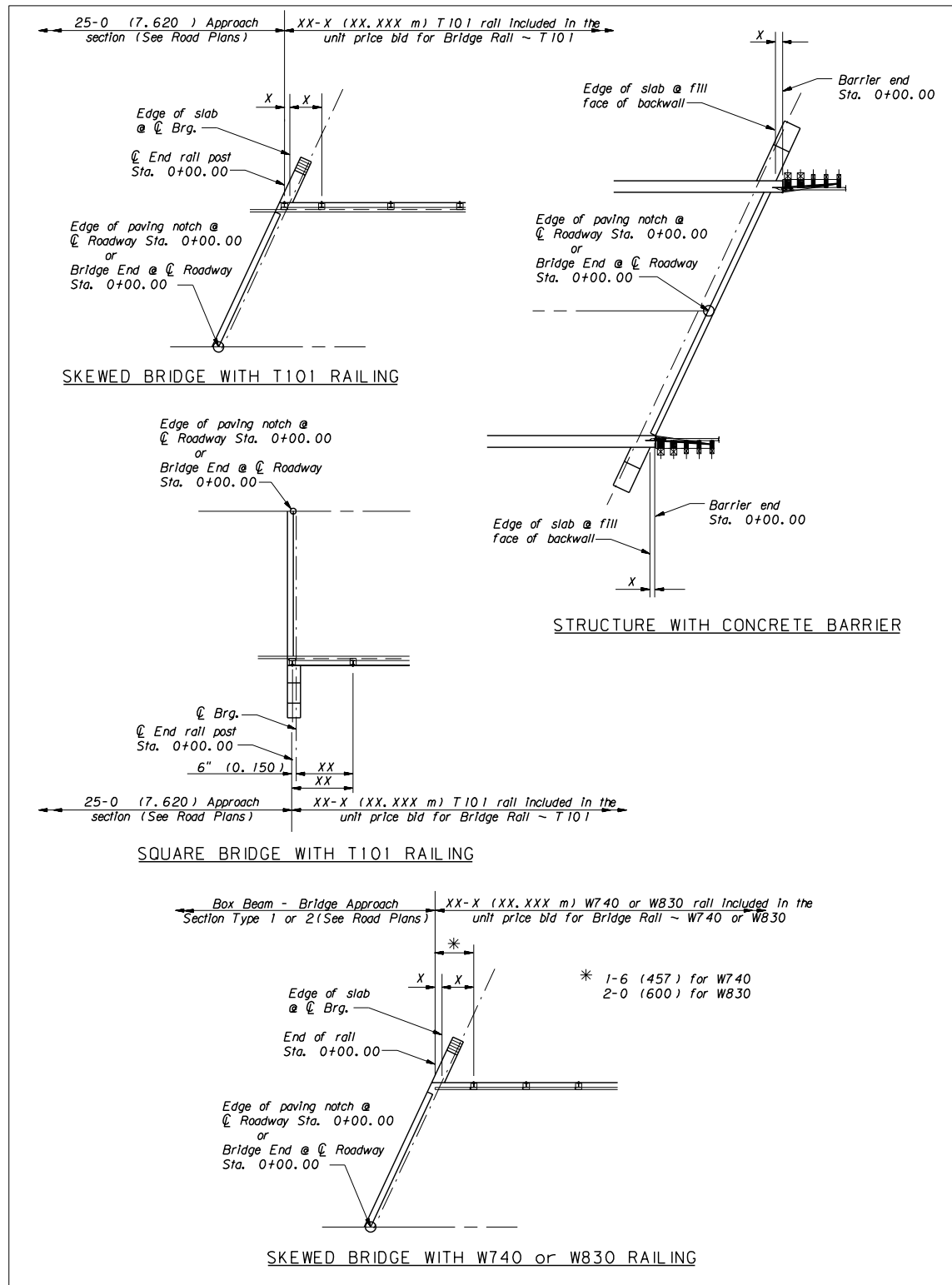
note the location of the drill-shaft anchor post, if required.

7. Curve Data. If the structure is on a horizontal curve, include the curve data on the plan view. Figure 5.4D presents the order and rounding accuracy that should be used to present the curve data.

8. Superelevation Transition. If superelevation transitioning will occur on the structure itself, include a superelevation transition figure on the General Layout Sheet. Coordinate the development of the transition figure with Road Design. Also include a cross section view of the bridge at each bent.

9. Miscellaneous Information. Where applicable, note the following information on the Plan View:

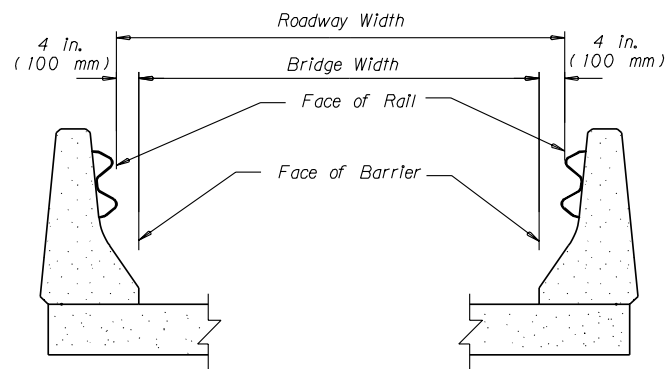
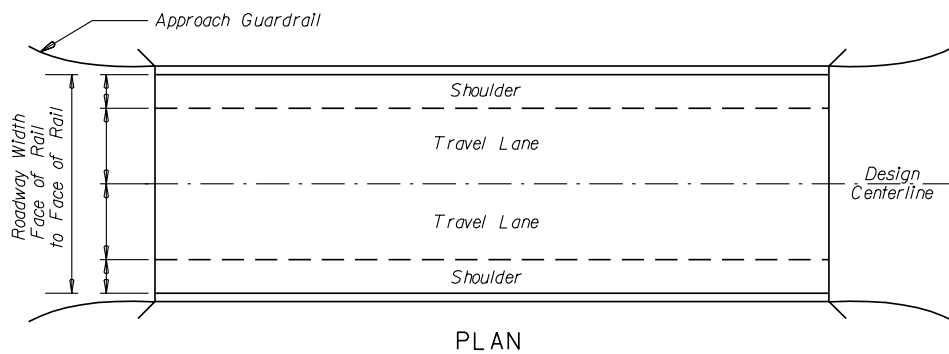
- a. North arrow;
- b. skew angle between the design centerline, or long chord on curved bridges, and the centerline at one or more of the bents;
- c. alignment data for roadway centerline;
- d. skew angle between the design centerline, or long chord on curved bridges, and the centerline at one or more of the bents;
- e. alignment data for roadway centerline;
- f. location of expansion joints;



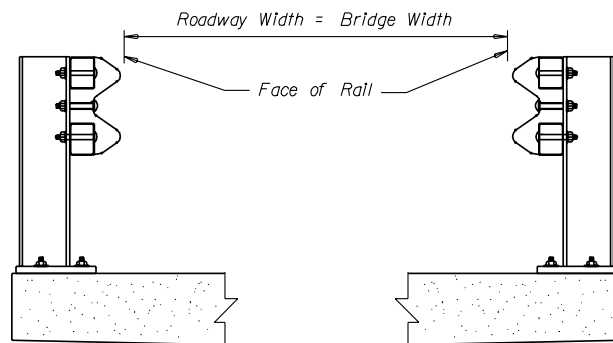
## STRUCTURE STATIONING

Figure 5.4B

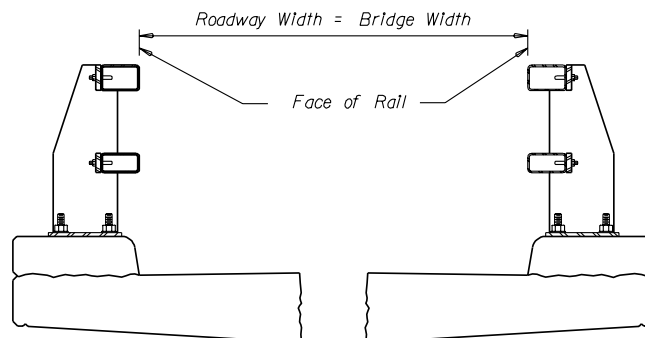
## ATTACHMENT I-B



CONCRETE BARRIER RAIL



T101 RAIL



SPIRAL CURVE DATA	SIMPLE CURVE DATA	ACCURACY	
		English	Metric
$\Delta$	$\Delta$	01° 01' 01"	01° 01' 01"
R <sub>C</sub> (existing)	R (existing)	.01 ft	0.001 m
R <sub>C</sub> (new)	R (new)	10 ft	5 m
L <sub>S</sub>		.01 ft	0.01 m
$\theta_S$		01° 01' 01"	01° 01' 01"
$\Delta_C$		01° 01' 01"	01° 01' 01"
T <sub>S</sub>	T	.01 ft	0.01 m
L <sub>C</sub>	L	.01 ft	0.01 m
E <sub>S</sub>	E	.01 ft	0.01 m
S	S	1%	1%

**HORIZONTAL CURVE DATA**  
(General Layout Sheets)

**Figure 5.4D**

- |   |   |
|---|---|
| <ul style="list-style-type: none"> <li>g. top and toe elevations of riprap;</li> <li>h. Slope rates of fills and cuts;</li> <li>i. name and flow direction of stream;</li> <li>j. centerlines for all bents;</li> <li>k. design centerlines of crossing highways and railroads;</li> <li>l. traffic direction and name of nearest locality, major street, landmark, etc.;</li> <li>m. traffic directions for crossing highway;</li> <li>n. name of crossing facility (e.g., river, railroad, highway);</li> <li>o. limits and type of slope protection;</li> <li>p. face of rail (T101 or Wyoming rail)<br/>face of barrier (Concrete Barrier rail)</li> <li>q. edge of slab;</li> <li>r. structure mounted signs or luminaires;</li> </ul> | <ul style="list-style-type: none"> <li>s. any utility attachments;</li> <li>t. location of Section A-A and Section B-B;</li> <li>u. joint or continuity condition of slabs at each bent; and/or</li> <li>v. any other notes applicable to the drawing.</li> </ul> |
|---|---|

**5.4.2.2 Elevation View**

Show the Elevation View of the structure directly below and in the same scale as the Plan View. Consider the following guidelines when preparing the Elevation View:

1. Structure. In general, only show the proposed structure in the Elevation View (i.e., do not show an existing structure to be removed). However, if sections of the existing structure will remain, they should be shown and noted as such. If the bridge is on a significant skew, an additional cross-section detail may be provided to clearly show the clearances, elevations, etc.

2. Bent Numbering. Consecutively number the bents by increasing stations.
3. Stationing. Note the station where the centerline of each bent crosses the design centerline.
4. Profiles. Show the ground line profile at the design centerline with a solid line and label it  $\nabla$  Profile. Show the right profile with a lighter dashed line ( \_ \_ \_ ) and left profile with a long dash-dot line ( \_ \_ . \_ \_ ). Also note the location of the right and left profiles [typically 20 ft. (6 m) Rt. Profile, 20 ft. (6 m) Lt. Profile.]
5. Elevations. Provide an elevation scale along the left side of the Elevation View. For English projects, segregate the scale into 1 ft. increments and note every 5th increment. Show all elevations on the sheet to 0.01 ft.
4. For metric projects, segregate the scale into 0.5 m increments and note the even whole increment. Show all elevations on the sheet to 0.001 m. Note the elevations for the following:
  - a. the finished roadway surface at the intersection of the design centerline and each bent centerline;
  - b. the bottom of each footing and, if deemed necessary, the top of the footing;
  - c. the bottom of existing footings to remain;
  - d. the highwater elevation, the water surface at the time of the survey and the low point of channel and Q2 flow elevation;
  - e. the top of key or toe of riprap;
  - f. the top and bottom of riprap;
  - g. the top of rail for railroads; and/or
  - h. the finished roadway surface for the roadway underneath the structure.
6. Dimensions. Dimensions on the Elevation View may include:
  - a. the horizontal distance from the centerline of end bearing to centerline of end bearing, measured along the span chord if the structure is on a curve;
  - b. the span distance between bents, measured along the span chord if the structure is on a curve;
  - c. actual minimum vertical clearances for railroad and highway bridges;
  - d. actual minimum horizontal clearances to bents for railroad and highway bridges; and/or
  - e. the location for terminating riprap.
7. Piles. For structures on pile footings, note the type of pile to be used. Where practical, show this information near the first abutment or bent.
8. Bridge Rail. Note the type of bridge rail used on the structure (e.g., T101, cast-in-place concrete barrier, guard fence, pedestrian rail).
9. Miscellaneous. Where applicable, note the following information on the Elevation View:
  - a. the type of shoe (e.g., fixed or expansion) at each bent;

- b. the type of superstructure beam (e.g., Prestressed Concrete Beam - Type IV, W36 x 194 Continuous Steel Beam);
- c. profile gradeline slopes;
- d. ties between the toe of slope and railroad tracks;
- e. riprap slopes;
- f. approval date for title block; and/or
- g. other construction requirements.

#### 5.4.2.3 End Bent Cross Section

Include a cross-sectional view of each end bent or abutment on the General Layout Sheet. Typically, these details are placed below the Elevation View. However, they may be placed elsewhere on the sheet where there is room. If the end bents or abutments are essentially the same, only one cross sectional view of one of the bents will be necessary. If two details are required, try to arrange the sheet so that the two details are next to each other. Consider the following information when developing the Cross Section Detail:

1. Scale. Select a scale so that the details and information can be easily read.
2. Slope Protection. Show the type, depth and slope rate for slope protection required. For waterway applications, the slope protection will typically be riprap. For riprap, also illustrate the placement at the toe of slope. Show riprap dimensions to the nearest 3 in. (0.1 m).
3. Berm. Dimension the width and indicate the slope of the berm on the cross section. Dimension the clearance between the top of

slope of berm and the beam seats of the bridge.

4. Bent or Abutment Details. Do not show the design details for end bents and abutments on this sheet. These are shown on the Bent Sheets; see Section 5.4.4.
5. Miscellaneous Information. Where applicable, note the following on the Cross Section Detail:
  - a. the location of the centerline bearing;
  - b. the type of beam;
  - c. the size and type of pile or drilled shaft, and whether or not the piles are vertical or battered; and/or
  - d. any other necessary details (e.g., backfill treatment next to the bent on the approach).

#### 5.4.2.4 Profile Grade Detail

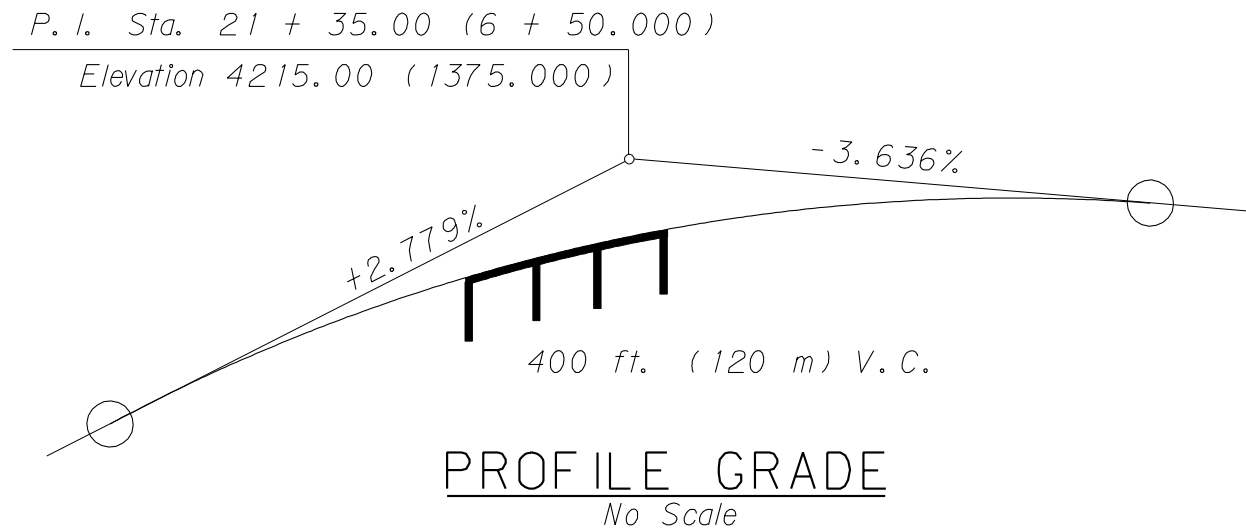
Include a Profile Grade Detail somewhere on the General Layout Sheet. The Profile Grade Detail does not need to be drawn to scale. Figure 5.4E illustrates a typical profile grade figure. Include the following information on the Profile Grade Detail:

- a. PI station,
- b. PI elevation,
- c. length of curve,
- d. grades shown to 0.001%, and
- e. location of structure on the profile.

**5.4.2.5 Notes**

Standard notes which apply to the entire project and notes which apply only to the General Layout Sheet should be placed in the upper, right-hand corner of the sheet. Also, include the

Stream Data Table in the general notes. A sample Stream Data Table can be found in the MDT publication **Standard Bridge Details and Notes**. For additional information on project notes, see Section 5.2.1.



**SAMPLE PROFILE GRADE DETAIL**

**Figure 5.4E**



### 5.4.3 Footings Plan Sheet

#### 5.4.3.1 Summary of Log of Borings

Show the Log of Borings across the top portion of the sheet. The information for the log details will be provided by the Geotechnical Section. When preparing the log details, consider the following guidelines:

1. Scales. Draft the logs to scale vertically. Space them so that they can all fit horizontally across one sheet. Plot the logs in order of increasing stations and not in order of borehole numbers. The width of the log is 6 ft wide using a 1:10 scale. For metric drawings the width of the log is 1500 mm using a 1:100 scale. Change the size proportionally to the scale so the bore log width is constant.
2. Identification. The borehole number and station location of the borehole will be provided by the Geotechnical Section. Include this information at the top of each borehole diagram. Also note the distance and location of each borehole from the design centerline.
3. Material Symbology. To illustrate the various material types within the boring log, use the material symbology as provided by the Geotechnical Section. Note the material type to the right of the borehole.
4. Elevations. The following will apply to showing elevations in the Log of Borings Detail:
  - a. Scale. Provide an elevation scale along the left side of the borehole logs. For most projects, segregate the scale into 1 ft increments and show the fifth and note the tenth increment. For metric projects, segregate the scale into .5m increments and note the even whole

increment. For clarification, light dotted lines may be shown horizontally across the log borings at selected intervals.

- b. Top and Bottom Elevations. Note the elevation at the top of the boring, where there is a material change, and at the bottom of the boring. Show all elevations to 0.01 m and to the left of the borehole diagram.
  - c. Ground Water Elevations. Note, to the right of the borehole, the top of ground water elevation and the date when the reading was taken. If no ground water levels were measured, note this next to the bore log.
5. Number of Blows. Graphically illustrate the amount of penetration achieved from the standard penetration test with a small, solid rectangle. This graphical illustration is based on the three penetration tests. Indicate the number of blows required to obtain a 6 in. (0.150-m) penetration to the right of the rectangle. The number of blows for each test will be separated from the subsequent test with a dash (e.g., 6-12-20). Where the full 6 in. (0.150-m) penetration is not obtained, show the blows followed by a slash and the depth of penetration achieved for that test.

For example (English), 30-50/.3 indicates a total depth of 0.8 ft ( $0.5 + 0.3$ ) and 20-40-50/.2 indicates a total depth of 1.2 ft ( $0.5 + 0.5 + 0.2$ ).

For example (Metric), 30-50/0.10 m indicates a total depth of 0.25 m ( $0.15 + 0.10$ ) and 20-40-50/.05 indicates a total depth of 0.35 m ( $0.15 + 0.15 + 0.05$ ).

The blow count boxes should be drawn 1 ft (305 mm) wide. Use a scale of 1"=10' for English projects or a scale of 1:100 for metric projects.

### 5.4.3.2 Footing Plan

Draw the Footing Plan to scale using the largest scale practical that will allow the Footing Plan to fit on one sheet. Place the Footing Plan directly underneath the Log of Borings. When preparing the Footing Plan, consider the following guidelines:

1. Footings. Show the Footing Plan for each bent. Note all applicable dimensions to determine the locations of all piles or drilled shafts. Where footings are the same from one bent to another, only show the dimensions on one bent and include a note that the dimensions for the other bents are the same. Show all dimensions to the nearest 1/16 in. (millimeter).
2. Bore Holes. Indicate the actual locations for all bore holes with the appropriate bore symbol. Note the bore hole number next to the symbol.
3. Pile or Shaft Locations. Show the locations of all piles or drilled shafts and note the size of the piles or drilled shaft diameters. Note the location of all battered piling. Indicate whether piling are bearing or friction piling. Also, note the locations and size of all test piles.
4. Stationing. Show the stations where the design centerline intersects the centerline for each bent. These stations will be the same as those shown in the Elevation View on the General Layout Sheet.
5. Dimensions. In addition to the footing dimensions (see Item #1), indicate the overall centerline of end bearing to centerline of end bearing dimension and the bent-to-bent span dimensions. These

dimensions will be same as those shown in the Elevation View on the General Layout Sheet.

6. Miscellaneous. Include the following information on the footing plan:
  - a. North arrow;
  - b. location of existing foundations;
  - c. traffic or stream flow directions;
  - d. design centerline and alignment data;
  - e. offset distances from the designated working line (i.e., tangent on chord) to centerline of substructure units;
  - f. amount of skew;
  - g. bearing and lengths of span and long chords;
  - h. phase locations; and/or
  - i. applicable notes (e.g., Dimensions for Bent No. 3 are the same as for Bent No. 1).

### 5.4.3.3 Notes

Desirably, the notes which apply to the Footing Plan Sheet should be placed in the upper, right corner of the sheet. Typical standard notes that will apply to this sheet can be found in the MDT publication **Standard Bridge Details and Notes**. This publication also includes the pile splice welding criteria which should be included with the Notes.

#### 5.4.4 Bent Sheets

##### 5.4.4.1 General

Each bent generally consists of one or more sheets depending on the features and complexity of the bent. All bents are numbered consecutively, in order of increasing stations. Place the bent sheets within the bridge plans in the numerical order of the bents. Where two or more bents are essentially the same, combine them onto one sheet and note the differences on the sheet. For example, this may require including a Table of Elevations to distinguish the different elevations for each bent. Draw bents on separate sheets if the superelevation varies significantly or if the bridge is on a curve. In general, try to place all the necessary details for each bent on one sheet. Where this is not practical, additional sheets may be placed immediately after the main bent sheet.

##### 5.4.4.2 Plan View

When drafting the Plan View of the bent, consider the following guidelines:

1. Scale. Select a scale which will allow both the Plan View and Elevation View of the bent to fit on one page and still be clear when showing the reinforcing details. Typically, a scale of  $\frac{1}{2}" = 1'$  or  $\frac{3}{8}" = 1'$  should be used. For metric, typically use a scale of 1:25 or 1:30. To reduce overcrowding, use a second sheet where the bent is too wide to fit on one page, if there are too many details to be seen clearly or if there is phase work on the bent.
2. Direction. Note the direction of the view (e.g., ahead on line) for each bent. Bent No. 1 is typically shown back on line, the remainder bents are shown ahead on line.
3. Cutaway View. For end bents and abutments, show a cutaway view of one or

two beams to illustrate the details for expansion joints, bearings, anchor bolts, etc. In the non-cutaway portion, show the beam or girder, bearing pad, etc., as hidden lines (i.e., dashed lines).

4. Dimensions. For each bent, show the dimensions for the following elements to the nearest 1/16 in. (millimeter):
  - a. Length (End Bents). On the top of the Plan View, show the overall length of the bent and the distances between:
    - the structure centerline and roadway design centerline;
    - the structure centerline and the face of rail along the fill face of the bent;
    - face of rail and edge of slab along the fill face of the bent;
    - where the end bent or abutment changes shape (e.g., flat, sloped) along the fill face of the bent; and
    - other dimensions as necessary for construction.
  - b. Length (Intermediate Bents). For intermediate bents, show the following dimensions:
    - the out-to-out dimensions of the foundation;
    - the overall length of the bent, measured at the foundation and at the top of cap;
    - the distance from the bent centerline to the outside of the cap;

- all dimensions where the bent cap changes shape; and
  - other dimensions as necessary for construction.
- c. Width (End Bent). Show the width for the following:
- the overall width of the backwall and the cap;
  - the distance from the bearing centerline to the back and front of the cap;
  - the thickness of the backwall; if the front of the backwall is not coincidental with the bearing centerline, note the distance from the bearing centerline to the back and front of the backwall;
  - the paving notch; and
  - other dimensions as necessary for construction.
- d. Width (Intermediate Bent). Show the width for the following:
- the overall width of the bent;
  - the distance from the bent centerline to the back and front of the bent;
  - where there are multiple beam seats, the dimension to the centerline of each beam seat from the centerline of the bent; and
  - other dimensions as necessary for construction.
- e. Shoes. Show an outline, to scale, of the bearing pads. Show all applicable dimensions to the anchor bolts. Include a note to see the shoe details. If the bearing pads are the same, only one bearing pad needs to be completely dimensioned.
- f. Beams or Girders. Show the dimensions for the following:
- between the roadway design centerline and adjacent beams or girders on either side of design centerline,
  - between the centerlines of each intermediate beam or girder, and
  - from the centerline of outside beam or girder to the edge of the cap or foundation.
- g. Steps. Show the width of each step spacing. Also, indicate the beam seat elevation at each step. Slope the cap between steps on end bents.
5. Reinforcing Steel. In general, do not show the location of reinforcing steel in the Plan View. However, reinforcing steel may be shown in the wingwall portion of the end bent. Where shown, note the bar types as discussed in Section 5.4.5.
6. Miscellaneous Details. The following are generally shown and labeled in the Plan View:
- a. face of rail,
  - b. edge of slab,
  - c. width and thickness of expansion joint,
  - d. centerline of bearing
  - e. centerline of bent,

- f. centerline of roadway and/or structure,
  - g. centerline of each beam or girder,
  - h. skew,
  - i. fill face and near face of end bents,
  - j. guard angle size and length,
  - k. metal expansion cap size and location,
  - l. anchor bolt size and location, and
  - m. other necessary construction details or notes.
- 4. Do not repeat dimensions shown in other views on the sheet.
  - 5. Where more than one bent is shown in the drawing, note where there are differences.
  - 6. Elevations. Record the elevation at the following locations on the bent:
    - a. for end bents, the roadway surface elevation at the face of the rail and at the crown of the roadway surface;
    - b. for intermediate bents, the low beam or girder seat elevation;
    - c. for end bents, the bottom of the cap;
    - d. for drilled shafts, the bottom elevation of the shaft; and
    - e. the top and bottom elevations for spread footings.

#### 5.4.4.3 Elevation View

Show the Elevation View directly below the Plan View and in the same scale as the Plan View. When preparing the Elevation View, consider the following:

- 1. Reinforcing. Bar reinforcing is typically illustrated in the Elevation View. If the bent is essentially symmetrical about a centerline, it will be acceptable, for clarity, to only show the reinforcing on half the bent. For guidance on bar detailing, see Section 5.4.5.
- 2. Dimensions. Consider the following when providing dimensions on the Elevation View:
  - a. Indicate the spacing between the centerlines of piles or drilled shafts.
  - b. Note the distance the piles are embedded into the cap.
- 3. Show all necessary dimensions which are required to construct the bent.
- 7. Cross Slope. Do not indicate the cross slope of the roadway surface.
- 8. Miscellaneous Details. The following may be shown or noted in the Elevation View:
  - a. for end bents, the beam or girder locations;
  - b. the bridge railing or barrier;
  - c. centerline of the bent and centerline of bearing, if different from the centerline of the bent;
  - d. design centerline of the roadway;
  - e. location and width of expansion joints;
  - f. location of construction joints;

- g. pile type and size or drilled shaft diameter;
- h. the type of concrete,
- i. Section A-A and Section B-B callouts; and
- j. other necessary construction notes.

#### 5.4.4.4 Cross Section View

Cross section views may be required on a Bent Sheet where it is considered necessary to illustrate construction details, the end diaphragm, reinforcing bar type and locations, and other information for various elements that cannot be adequately addressed in the Plan and Elevation Views. Where practical, place these views on the same sheet as the Plan and Elevation Views. However, for large or complex designs, cross section views may be placed on a second sheet after the main bent sheet.

#### 5.4.4.5 Miscellaneous Details

In addition to the details discussed in the previous sections, the following may appear on the Bent Sheet:

1. Notes. See the Department publication **Standard Bridge Details and Notes** for the typical notes that may be placed on a Bent Sheet. General notes may be placed anywhere there is room on the sheet. Where practical, try to group these notes in one location on the sheet. Notes which apply to a specific detail should be placed next to or within the detail itself.
2. Details. The following miscellaneous details may be included on the Bent Sheet:
  - a. Metal Expansion Cap Detail,

- b. Waterstop Detail,
- c. Guard Angle Detail,
- d. Nose Angle Detail,
- e. Tie Bar Detail, and/or
- f. Anchor Bolt Detail.

Examples of these details can be found in the **Standard Bridge Details and Notes** and in the typical plans sheets in Volume III of this **Manual**. Place these details where there is room on the sheet. Typically, they should be placed along the bottom of the sheet or below the Bill of Reinforcing Steel.

3. Table of Elevations. Figure 5.4F illustrates a typical Table of Elevations. A Table of Elevations may be included on the sheet where:

- a. there is a need to reduce clutter on the sheet, or
- b. where two or more bents are illustrated on one sheet.

Note the corresponding elevation locations in the various views with capital letters (e.g., Elev. B).

4. Orientation View. An orientation view may be added to the Bent Sheet to illustrate the various elevations on a cross section of the bent. Generally, orientation views are only provided where the roadway is superelevated across the structure.

### 5.4.5 Reinforcing Steel

#### 5.4.5.1 Bar Detailing

Consider the following guidelines when detailing reinforcing bars:

1. Plan Notation. Clearly indicate the size, location and spacing of reinforcing bars in all plan, elevation and cross-section views.

The number of reinforcing bars should only be called out in one view. Where the same bar is shown in other views, only note the bar mark and size in the second view.

2. Epoxy Coated Reinforcing. Use epoxy coated reinforcement for all steel in or extending into the slab, except for shear bars in prestress beams. Also, all diaphragm reinforcing are to be epoxy coated.
3. Seismic Reinforcing. A 706 reinforcing may be required in seismic areas. If in doubt, consult with the design engineer.
4. Bar Mark. For referencing purposes, each reinforcing bar in the various views and details is labeled with a letter prefix, number and, where applicable, a letter suffix and special notes which describe the spacing, type of bar, etc. (e.g., 2-BW17E~#4 U-Bars). Figure 5.4G illustrates the prefix and suffixes that should be used to denote the bar types. Consecutively number each bar type group on each sheet beginning with #1 (e.g., BW1, BW2, P1, P2). When numbering bars, number them top to bottom, left to right as they appear in the elevation view or cross section view.
5. Clarity. To reduce clutter on a detail, only the first and the last bar of a series needs to be drawn. However, indicate the number of bars in between. In cross-section views, show the location of all bars.
6. Bar Types. Where practical, make similar bars alike to reduce the number of different bars in a structure.
7. Spacing Dimensioning. All spacing dimensions are measured on centerlines of bars, except where “cover” (e.g., 2", 50 Cl.) is indicated. Cover is measured from the outside edge of bar to the outside edge of the concrete.
8. Drafting Guidelines. Consider the following drafting guidelines when detailing reinforcing bars:
  - c. In an elevation or plan view, show reinforcing bars as a single solid line. However for details with a scale of 1 1/2" = 1' (1:10) or larger, each bar may be shown with two parallel lines.
  - d. Bends of standard hooks and stirrups are generally not dimensioned. However, draft all bends to scale.
  - e. Sections cut at specific locations along a member will often be preferred over an elevation view for complex reinforcing patterns.
  - d. Show corner bars enclosed by stirrups or ties at the corner of the bend.

#### 5.4.5.2 Bill of Reinforcing Steel Table

A Bill of Reinforcing Steel Table is required wherever reinforcing bars are shown on a sheet (e.g., Bent Sheet, Slab Sheets, Detail Sheets). This table is used to depict the bar shapes, sizes, lengths and qualities. Figure 5.4H illustrates a sample reinforcing table. Place the table in the upper, right-hand corner of the sheet. Where it is necessary to add details to a second page, combine the reinforcing details with the appropriate first sheet. For example, if to prevent overcrowding there are two sheets for a bent, the reinforcing table is only shown on the first sheet for the bent. When preparing the table, consider the following guidelines:

1. Bar Shape. In the top portion of the table, show the various shapes of the bars used on the sheet. Figure 5.4H.2 and 5.4H.3 illustrates typical bar shape details. Number each bar type (e.g., Type 1, Type 17) in each table. For each bar type, denote

each dimension of the bar as Figures 5.4H.2  
and 5.4H.3 show.



5.

TABLE OF ELEVATIONS				
Location	Bent No. 1		Bent No. 4	
	English	Metric	English	Metric
A	3488.17	1063.195	3481.55	1061.175
B	3487.84	1063.095	3481.45	1061.145
C	3488.02	1063.150	3481.20	1061.070
D	3482.45	1061.450	3476.00	1059.485
E	3482.63	1061.505	3476.07	1059.505
F	3482.68	1061.520	3476.00	1059.485
G	3482.60	1061.495	3475.80	1059.425
H	3479.17	1060.450	3472.52	1058.425

**SAMPLE TABLE OF ELEVATIONS****Figure 5.4 F**

Prefixes	Bar Type	Suffixes	Bar Type
B	Bent Cap	E	Epoxy Coated
BM	Concrete Beam	W	ASTM A706 Reinforcing Steel
B100	Concrete Bridge Rail		
BW	Backwall		
C	Curb		
CL	Column		
D	Dowels		
D	Diaphragm		
DS	Drilled Shaft		
F	Footing		
P	Pier		
S	Miscellaneous Slab		
S100	Transverse Slab		
S200	Top Longitudinal Slab		
S300	Bottom Longitudinal Slab		
SB	Shear Block		
T	Ties/Stiffeners		
WW	Wing Walls		

### REINFORCING BAR DESIGNATIONS

Figure 5.4G

2. Table Format. Figure 5.4H.1 illustrates the typical format for a reinforcing table. Note that straight bars are listed first and then the bent bars. List the bars first in alphabetical order and then numeric order. The number of columns should be appropriate with the information provided (i.e., do not show blank columns).
3. Length. Note the following when determining the length of reinforcing steel:
  - a. The upper limit for reinforcing steel lengths is 60 ft for #5 bars (18300 mm for #16 bars) and larger, and 40 ft for #4 bars (12190 mm for # 13 bars).
  - b. Horizontal bars in backwalls should be lapped at centerline structure instead of being full width bars.
  - c. For longitudinal slab steel, add 4 in. (100 mm) per lap to the calculated lengths to account for construction tolerances.
  - d. Round all reinforcing bar lengths to multiples of 1 in. 10 mm. When rounding off lengths of bars, ensure that the length does not encroach upon the minimum clearances.
  - e. For bent bars, the overall lengths will be the sum of all legs. Measure all dimensions on bent bars using the out-to-out dimension.

#### **5.4.6 Slab Detail Sheet**

##### **5.4.6.1 General**

The Slab Detail Sheet may be included as a Standard Drawing, or it may consist of a separate plan sheet with all the necessary

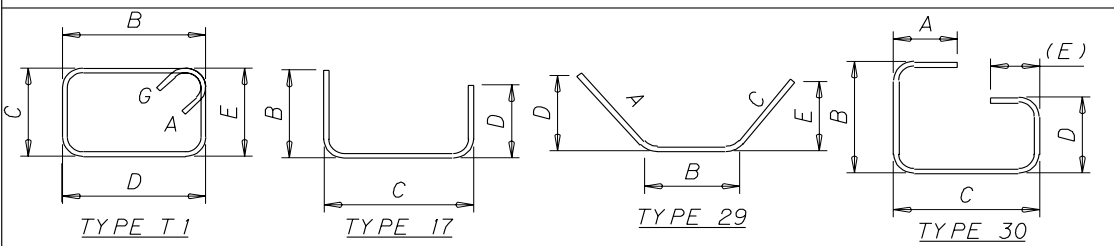
information. In addition to the information presented in the following sections, the following details may be included on a Slab Detail Sheet:

1. Erection Plan. For prestressed concrete structures, the Erection Plan will typically be included on the Slab Detail Sheet. However, for steel structures, the Erection Plan will typically be shown on a separate sheet. Section 5.4.7 discusses the information that should be shown in an Erection Plan Detail.
2. Miscellaneous Details. The following miscellaneous details should be shown on the Slab Detail Sheet if applicable:
  - a. Shear Key Detail
  - b. Drain Detail
  - c. Barrier Detail
  - d. Utility hangers

##### **5.4.6.2 Reinforcing Steel Placement Diagram**

The Reinforcing Steel Placement Diagram, a plan view of the deck or a portion of the deck, is used to illustrate the placing of reinforcing steel within the slab. When detailing this diagram, note the following:

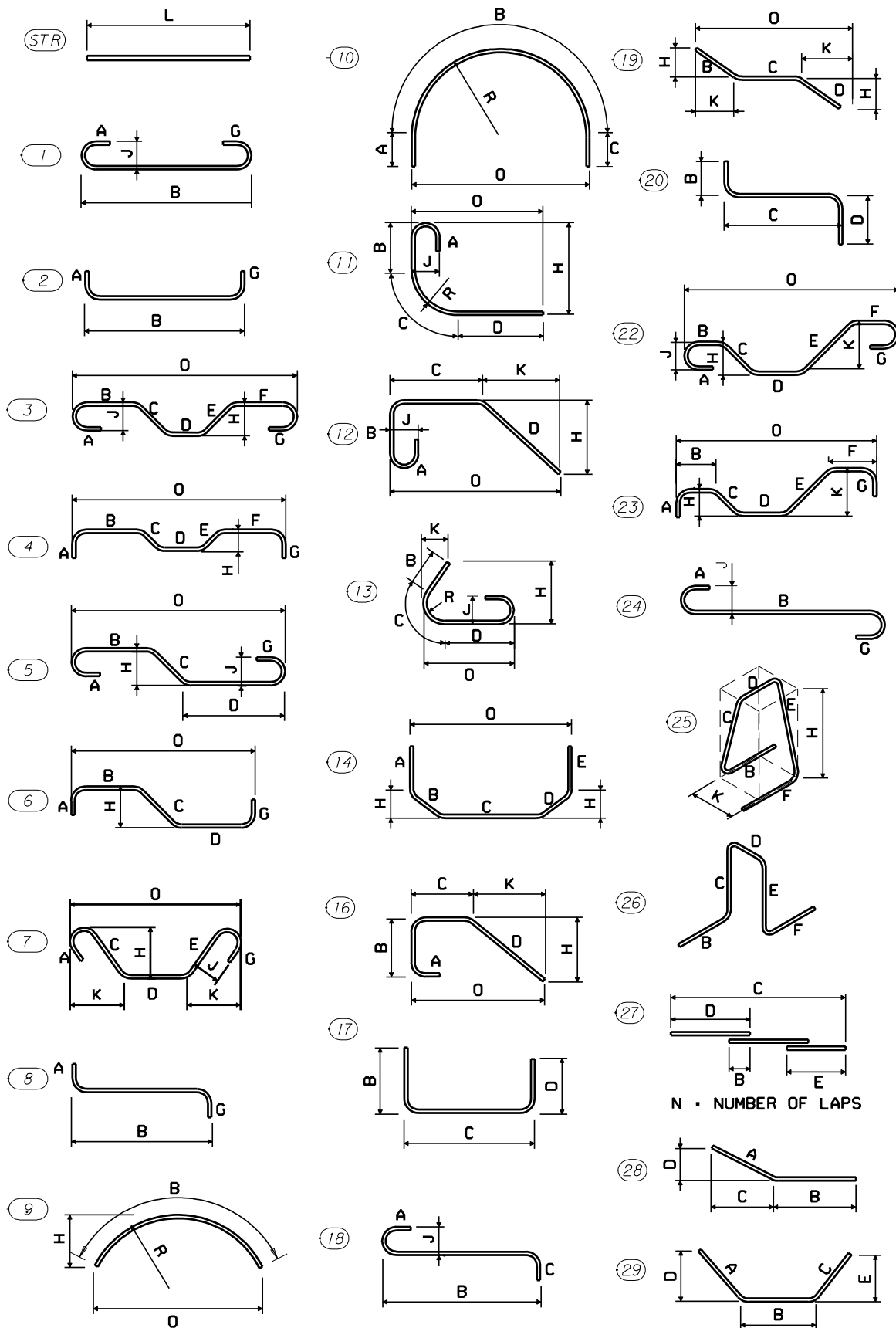
1. Scale. Select a scale that will allow the diagram to fit on one sheet with the other necessary details and still be large enough to allow clear detailing of the reinforcing steel.
2. Detailing. For the standard slab bars (e.g., S100E, S200E, S300E), it will only be necessary to show the first and last bar in a series.

BILL OF REINFORCING STEEL					(FOR ONE BENT ONLY) ( All dimensions are out to out )					
										
Mark	Size	No.	Type	Length	A	B	C	D	E	G
BW 1E	#16	4	STR	9 270						
BW2	#16	4	STR	6 560						
BW3	#16	2	STR	6 440						
BW4	#16	2	STR	6 100						
BW5	#13	4	STR	2 310						
BW6	#13	2	STR	2 200						
BW7	#13	2	STR	1 810						
BW8a	#13	4	STR	1 170						
BW8b	#13	4	STR	860						
BW8c	#13	4	STR	550						
BW9	#13	12	STR	1 320						
BW 10E	#13	24	30	2 730	160	1 150	400	860	160	
BW 11E	#13	2	T 1	5 240	120	2 100	400	2 100	400	120
BW 12a	#13	2	T 1	5 160	120	2 060	400	2 060	400	120
BW 12b	#13	2	T 1	4 760	120	1 860	400	1 860	400	120
BW 12c	#13	2	T 1	4 340	120	1 650	400	1 650	400	120
BW 12d	#13	2	T 1	3 940	120	1 450	400	1 450	400	120
BW 12e	#13	2	T 1	3 540	120	1 250	400	1 250	400	120
BW 13	#13	2	T 1	2 860	120	910	400	910	400	120
BW 14	#13	6	29	2 740	410	2 100	230	330	150	
BW 15E	#13	2	29	2 810	1 670	630	510	760	460	
BW 16E	#13	1	29	2 560	1 420	630	510	640	460	
BW 17E	#13	2	29	2 740	1 590	630	510	720	460	
BW 18E	#13	1	29	2 350	1 210	630	510	550	460	
BW 19E	#13	22	17	1 220		610	610			
BW20	#19	5	STR	1 370						
BW21	#13	4	STR	1 200						
B1	#22	8	STR	8 600						
B2	#13	4	STR	8 600						
B3	#13	6	STR	1 120						
B4	#13	3	STR	1 650						
B5	#13	28	T 1	3 780	120	900	870	900	870	120
B6	#13	5	17	2 640		870	900	870		
B7	#13	20	17	1 800		450	900	450		
B8	#22	4	STR	1 480						
D1 *	32	5	STR	1 200						

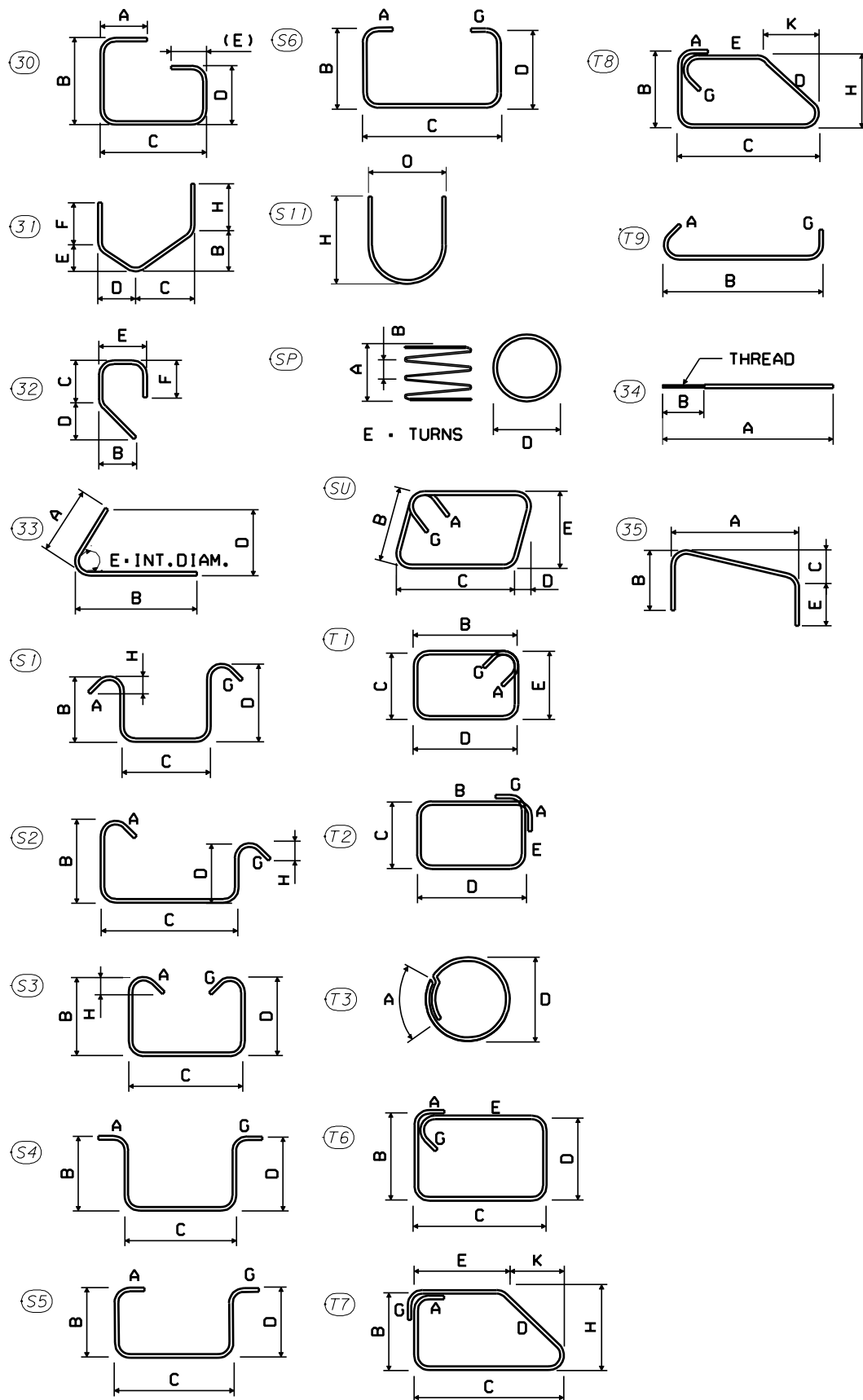
\*NOTE: Use D1~32 mm  $\varnothing$  smooth bars meeting the requirements of AASHTO M 270M Grade 250.

NOTE: The suffix E denotes epoxy coated reinforcing steel.

**Bill of Reinforcing Steel Example**  
**Figure 5.4H.1**



Standard Bar Types  
Figure 5.4H.2



Standard Bar Types  
Figure 5.4H.3

3. Transverse Bars. Transverse bars are generally denoted using the S100E series. Bar mark S100E is generally reserved for the typical full-length transverse bar in the structure. Bar marks S101E and higher are used to designate bars near the end bent when the structure is skewed. On a case-by-case basis, placing all transverse bars on the skew may be investigated for minor skew angles. This investigation should check the interference between transverse bars and the stirrups or shear studs. For each bar, record the bar mark, the bar size, the spacing between bars, and the number of bars in the top and bottom rows.
  4. Longitudinal Bars. Longitudinal bars are generally denoted using the following:
    - a. Top Bars. Longitudinal bars placed on the top of slab and parallel with the structure are generally denoted with bar mark S200E. Bar marks S201E and higher are typically used to designate overlap bars.
    - b. Bottom Bars. Longitudinal bars placed on the bottom of slab and parallel with the structure are generally denoted with bar mark S300E. Bar marks S301E and higher are used to designate overlapping bars.
    - c. Notation. For each bar, record the bar size, the location in slab (e.g., top, bottom), the number per line, the number of lines and the spacing between bars.
  5. Miscellaneous Bars. Additional bars placed over bents and to strengthen the edge for the bridge rail, barriers, sidewalks or for other reasons are generally denoted with an “S” prefix. Note the number of bars, the bar mark, bar spacing and any placement guidelines on the detail. The length and location of these bars should also be clearly shown in the diagram. Include the diaphragm bars in this Bill of Reinforcing Steel Table. The diaphragm bars are to be epoxy coated.
  6. Dimensions. In addition to the length of reinforcing bars, also provide dimensions for the following:
    - a. all necessary dimensions from the bent or roadway centerlines to determine the location and placement of miscellaneous reinforcing bars,
    - b. spacing and orientation of transverse reinforcing bars,
    - c. lap lengths required for slab reinforcing steel,
    - d. the width from the roadway centerline to the face of rail or barrier,
    - e. the width of the barrier or from the face of rail to the edge of slab, and
    - f. the overall width of the slab.
  7. Miscellaneous Information. Provide the following items on the Reinforcing Steel Placement Diagram:
    - a. design centerline of the roadway,
    - b. centerlines of each bent,
    - c. edge of slab,
    - d. face of rail or barrier, and
    - e. any symmetry notes.
- ### 5.4.6.3 Slab Transverse Section
- The Slab Transverse Section is a cross-section view of the superstructure. Typically, the view should be looking ahead on line. The cross-section view is typically shown just beyond an

intermediate bent. When preparing the Slab Transverse Section, consider the following:

1. Scale. Select a scale that will adequately show the necessary details of the section.
2. Partial Sections. For sections which are essentially symmetrical about the centerline, only half the section needs to be shown. Note in the title for the detail that it is a partial slab transverse section. Variable sections or dissimilar overhangs typically will require a complete cross-section view.
3. Slab Thickness. Note the slab thickness at the following locations:
  4. Edge of Slab. On the side of the structure at the outside edge, note the slab thickness, if not standard.
  5. Interior. Somewhere between a pair of interior beams or girders, show the slab thickness with the following note, *Slab "T" = x* where x is the thickness in inches (millimeters).
  6. Interior Beam or Girder. The following will apply:
    - a. Concrete Beams and Rolled Steel Girders. Over an interior beam or girder, show the haunch depth and include the following notation, \**"D"*. The asterisk should lead the reader to the following note, *D = x in. (mm)* from the top of slab to top of web at  $\nabla$  of Brg. D varies at tenth points. See Dead Load Deflection Table on Dwg. No. xxxxx.
  7. Welded Plate Girders. For a welded plate girder, *"D"* is the distance from the top of the web to the top of the slab at the centerline of the girder. Include the following note, *D = x in. (mm) at  $\nabla$  Bearing*,  
*Measurement is from top of slab to top of web.*
8. Beams or Girders. The transverse section should illustrate the type and size of concrete beam or steel girder used on the structure. In addition, show the following dimensions:
  - a. the distance from the outside edge of the slab to the centerline of the first beam or girder,
  - b. the haunch width for steel girders,
  - c. the width between the centerlines of the interior beams or girders, and
  - d. the distance from the roadway centerline to the centerlines of the beams or girders adjacent to the roadway centerline.
9. Reinforcing. The Slab Transverse Section should indicate the location of the reinforcing steel within the slab. Section 5.4.6.2 discusses the nomenclature to be used for denoting reinforcing steel. Show all applicable spacing and location dimensions for the placement of reinforcing bars. Also include the minimum cover requirements for both the top and bottom. Typically, this will be 2 3/8 in. (60 mm) for the top and 1 in. (25 mm) for the bottom.
10. Barrier and Rail Details. Show the bridge rail or concrete barrier on the transverse section. Bridge rail construction details will be included as a Standard Drawing or as a separate detail sheet. For concrete barriers, construction and reinforcement details may be included in a detail on the Slab Detail Sheet or placed on a separate detail sheet. Show utility conduit in the barrier on all barrier details.
11. Roadway Features. Show all roadway structural features that are included on the



structure (e.g., raised medians, sidewalks). Construction and reinforcement details may be included in a detail on the Slab Detail Sheet or placed on a miscellaneous detail sheet.

12. Miscellaneous Information. Include the following miscellaneous information in the Slab Transverse Section detail:

- a. Centerline. Note the roadway design centerline and the centerlines for each beam or girder.
- b. Slope Indicator. Show the slope indicator for the roadway surface, and note the roadway slope to the nearest percent above the indicator. Note that the indicator arrow should point away from the crown.
- c. Utilities. Draw and call out threaded inserts in the transverse section, refer to standard slab drawings.
- d. Drip Groove. Note the location and size of the drip groove placed underneath the outside edge of slab.

#### 5.4.6.4 Slab Pouring Sequence

Include a slab pouring sequence on the Slab Detail Sheet for continuous steel structures and precast prestressed concrete structures designed to be continuous for live load. A slab pouring sequence is not needed for bridge decks with less than 100 yd<sup>3</sup> (75 m<sup>3</sup>). A slab pouring sequence should be included for bridge decks with more than 175 yd<sup>3</sup> (125 m<sup>3</sup>). For bridge decks between 100-175 yd<sup>3</sup> (75 m<sup>3</sup> – 125 m<sup>3</sup>) the need for a slab pouring sequence should be evaluated on a case-by-case basis. Chapter Fifteen discusses the criteria for determining the order of slab pouring. The slab pouring sequence detail should include the following information:

1. Notations. Note the pour sequence with numbers inscribed in circles. Include the following note next to the detail, The numbers inscribed in the circle represent the sequence of placing sections of the slab.
2. Dimensions. Show the length of each pour. Select pour lengths which are in 5 ft. (1000 mm) increments or, where necessary, 1 ft. (500 mm) increments. Also include the necessary dimensions from the end bearings to determine the pour length locations. Do not include the span distances between bents or the overall bridge length.
3. Additional Information. Show the following information on the Slab Pouring Sequence detail:
  - a. the centerline of bearings and bents,
  - b. a note and arrow indicating the direction of concrete placement, and
  - c. the location of the various project phases.

#### 5.4.6.5 Bill of Reinforcing Steel

A Bill of Reinforcing Steel Table should be placed in the upper, right-hand corner of the sheet. Section 5.4.5.2 discusses the procedures for preparing this table.

### 5.4.7 Erection Plan Sheet

#### 5.4.7.1 General

The Erection Plan Sheet illustrates the placement of steel girders, concrete beams, splice locations, stiffener locations, diaphragm locations and other details. The extent of details placed on the sheet will depend upon whether the structure is steel or concrete, the project

complexity, the amount of skew, etc. To determine the information that should be placed on the sheet, the designer should consider the following:

1. Concrete Bridges. For concrete bridges, the Erection Plan Sheet may consist of the following items:

- a. Erection Plan Detail (see Section 5.4.7.2);
- b. Reinforcing Steel Placement Diagram and Bill of Reinforcing Steel Table (see Sections 5.4.6.2 and 5.4.5.2, respectively);
- c. Slab Transverse Section (see Section 5.4.6.3);
- d. Dead Load Deflection Table (see Section 5.4.7.3);
- e. Beam Design Stresses Table (see Section 5.4.7.3); and
- f. other miscellaneous details.

2. Steel Bridges. The Erection Plan Sheet for the steel bridge will typically consist of the Erection Plan View and one or more of the following details depending on the room on the sheet:

- a. Longitudinal Section (see Section 5.4.9.3),
- b. Stiffener Details, and
- c. other miscellaneous details.
- d. Erection Plan Detail

When preparing the Erection Plan Detail, consider the following:

1. Scale. Draw the Erection Plan Detail to scale, using the largest scale practical that will show the necessary beam or girder placement and still fit in the room available on the sheet.
2. Symmetry. Where the structure is essentially symmetrical about a line, only half the structure needs to be shown. If only half the structure is shown, note that the structure is symmetrical about a line, typically the structure centerline.
3. Beam or Girder Numbering. For reference purposes, the designer may elect to label each beam or girder using an alphanumeric nomenclature (e.g., B1, B2, G4, G5). Where used, consecutively number the beams or girders from top to bottom.
4. Dimensions. Tie all dimensions to the design, bearing or bent centerlines. Show the following dimension on the Erection Plan Detail:
5. Beam or Girder Spacing. All distances are measured from the centerlines of the beams or girders. Show the spacing between:
  - a. each beam or girder,
  - b. the roadway design centerline and adjacent beams or girders on either side of the design centerline, and
  - c. the overall width between the two outside beams or girders.
  - d. Field Splice Location. For steel structures, indicate the location of the field splice and distance between:
  - e. the end bearings and the field splice, and
  - f. intermediate field splices.

This is typically shown above the detail.

- a. Diaphragm Spacing. Note the spacing between:
  - b. the end bearing and the first intermediate diaphragm,
  - c. intermediate diaphragms, and
  - d. the centerline of an intermediate bent and intermediate diaphragms on either side of the bent.
  - e. Where the distances are consistent between beams or girders, only show the dimensions for one beam or girder.
  - f. Stiffeners. For steel structures, provide sufficient dimensions to allow the contractor to determine the location of all stiffeners.
6. Miscellaneous Information. Note the following applicable information on the detail:
- a. roadway design or structure centerline,
  - b. bearing and bent centerlines,
  - c. the skew angle, and
  - d. the beam or girder type.

### 5.4.7.3 Tables

The following two tables may be shown on the Erection Plan Sheet:

1. Dead Load Deflection Table. For steel structures, if a separate Camber Sheet is not included within the plans, a dead load deflection table may be placed on this sheet or on the Diaphragm Detail Sheet. For concrete structures, the table is typically located on the Erection Plan Sheet. This table indicates the expected deflection, in inches (millimeters), to the nearest 1/16 in.

(millimeter) of the beam or girder at each tenth point of a span and at the field splices due to the dead load weight of the superstructure. The deflections are noted for each beam or girder. Use the beam or girder reference notations as discussed in Section 5.4.7.2. However, beams or girders with the same deflection can be combined on the table. The detail for a dead load deflection table is provided in the **Standard Bridge Details and Notes**.

2. Beam Design Stress Table. For concrete structures, include a Beam Design Stress Table with the dead load deflection table. Note the beam stresses for each beam. The beams are referenced as discussed in Section 5.4.7.2. Where the beams are the same length, they can be combined in the table. The detail for a Beam Design Stress Table is provided in the **Standard Bridge Details and Notes**. Round deflections to the nearest 1/16 in. (millimeter). Round shears and reactions to .1 klp (kN) and moments kip.ft (kN-m) to 3 significant digits.

## 5.4.8 Concrete Beam or Steel Girder Sheet

### 5.4.8.1 Concrete Beams

For most projects with concrete beams, the details shown in the Standard Drawings will be acceptable. Place this sheet at the end of the plans with the project Standard Drawings. However, if the Standard Drawing needs to be revised for the project, include a separate Concrete Beam Detail Sheet after the Erection Plan Sheet and do not include the Standard Drawing. If revisions are made to the Standard Drawing, the Standard Drawing reference must be removed from the sheet placed after the Erection Plan Sheet. However, if minor changes are required (e.g., modification of beam ends for skewed bridges), these may be included as

miscellaneous details on the Erection Plan Sheet or another miscellaneous detail sheet.

### 5.4.8.2 Steel Girders

For steel structures, a separate Girder Detail Sheet will typically be provided. When preparing the Girder Detail Sheet, consider the following guidelines:

1. Girder Elevation. Place the Girder Elevation View in the upper, left-hand portion of the sheet. It may or may not be drawn to scale. The view must be sufficiently large to illustrate the placement of shear studs, splices, stiffeners and diaphragms. This will typically require the beam to be shown in two or more sections. When detailing the Girder Elevation View, consider the following:
  - a. Steel Size. For rolled shapes, note the size of the beam. For plate girders, note the plate sizes and lengths for the top flange, web and bottom flange. If there are changes in the plate sizes, these should be noted. For rolled and plate girders, also note the steel size for the stiffeners.
  - b. Shear Studs. Show the location of the shear stud on the girder and note the spacing of the shear studs. The spacing is typically recorded directly above the girder with the number of studs, spacing and overall distance for each spacing group (e.g., 28 spacings @ 2'-0" (310 mm) = 56'-0" (8680 mm)).
  - c. Splices. Note the distances between the end bearings and first field splice from both ends of the structure and the distances between field splices.
  - d. Girder Stresses. For plate girders, note whether the stresses in the top and bottom flanges are in tension, compression or reversal, and the distance over which each stress type applies. The top flange stresses should be noted above the girder and the bottom flange stresses below the girder.
  - e. Dimension Lines. On the left side of each figure, note the various dimension line types (e.g., shear stud spacing, field splice spacing, top flange, bottom flange).
  - f. Centerlines. Show the centerlines for the end bearings and all intermediate bents. It will not be necessary to note the spacing between the various centerlines because these will be shown in the General Layout and Foundation Sheets.
2. Splice Details. If room is available on the sheet, include the shop or field splice details. If there is limited space on the sheet, these details may be included on the Splice Detail Sheet. Section 5.4.9.2 discusses the information that may be included with this detail.
3. Shear Stud Details. Somewhere on the sheet, show a cross section detail of the girder with the shear studs. Figure 5.4I illustrates a typical shear stud detail. The detail should note the:
  - a. location of the studs (i.e., spacing from the girder edge and the spacing between the studs); and
  - b. size of the studs. The contractor will typically be given two sizes from which to choose. The size of the stud will determine the number of studs in a row

to be placed on the girder, typically 3 or 4 in a row.

#### 5.4.9 Miscellaneous Details

To avoid overcrowding on a sheet or to improve its readability, separate detail sheets may be provided to illustrate various details. These sheets should be placed at the back of the bridge construction plans, just ahead of the bridge Standard Drawings. One or more of these details may be combined on a sheet. The following sections discuss these miscellaneous detail sheets.

##### 5.4.9.1 Camber Diagram Sheet

For complex designs, it may be necessary to include a Camber Diagram Sheet to show the deflection and design criteria. For simpler structures the camber information may be included as part of another sheet; see Section 5.4.7.3. A Camber Diagram Sheet will typically include the following:

1. Table of Camber Information. This table indicates the amount of camber, to the nearest 1/16 in. (millimeter), that will be necessary for each girder at the tenth points of each span and at the field splices. Note the camber distances for each girder using the girder references as discussed in Section 5.4.7.2. However, girders with the same camber designs can be combined in the table. The Table of Camber, at each tenth point of a span and at the field splice, should include the following information:
  - a. the amount of deflection due to the dead load weight of the diaphragms and girders;
  - b. the total dead load weight of the superstructure;

- c. where necessary, the necessary correction for a vertical curve; and
- d. the total camber required.

2. Table of Design Information. Include a table of design values for the moments, shears and reactions for each girder on the structure. Round the shears and reactions to .1 kip (kN) and moments kip.ft (kN·m) values to 3 significant digits.
3. Girder Camber Diagram. A Girder Camber Diagram may be included on the sheet to illustrate:
  - a. the location of the deflections for each tenth point on the span,
  - b. the location of field splices
  - c. the string line slope (see Item #4 below), and
  - d. the vertical curve offset.

The diagram is drawn using an exaggerated vertical scale.

4. String Line Slope Table. Note the string line (straight line) slope, to 0.0001 m/m, between each bent span.
5. Notes. Note all assumptions used to make the calculations.

##### 5.4.9.2 Splice Detail for Steel Girders

Where there is insufficient room on the Girder Detail Sheet, the splice details may be shown on a Splice Detail Sheet. The splice details, as applicable, should show the following:

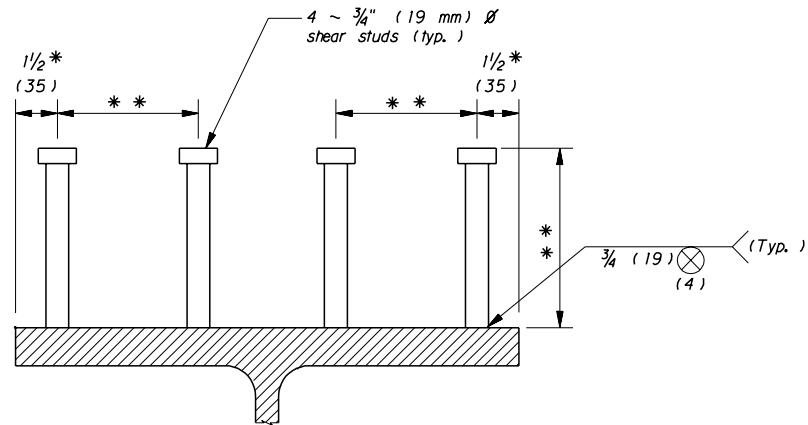
1. Welded Splices. Show all necessary welding details for the flanges and web.

Note the weld sizes, minimum and maximum allowable sizes after grinding, testing requirements and allowable welding distances between flange and web splices.

2. Bolted Splices. Three views will typically be required to show all the necessary details for the bolted splices — an elevation view of

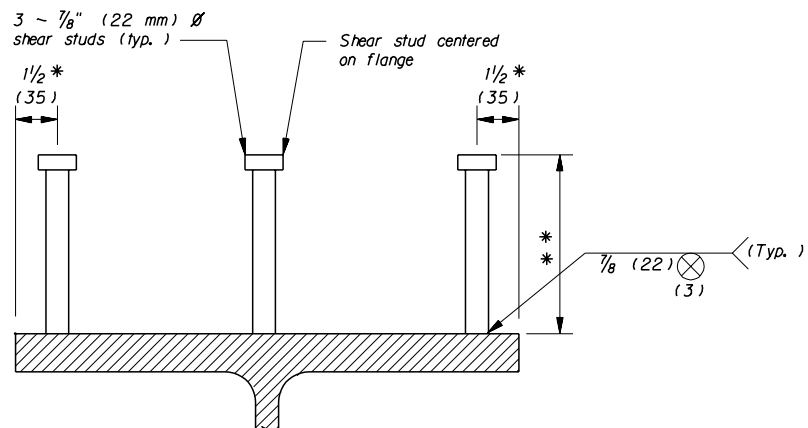
the girder and web, top or bottom view of the flange and a cross section view of the flange. Each view should show:

- a. the bolt hole locations, including all necessary dimensions;



\* Set dimension

\*\* Dimensions determined  
by the design



## SAMPLE SHEAR STUD

- b. the diameter of the bolt holes;
- c. the bolt holes as filled;
- d. the attachment plates, also note the plate sizes; and
- e. a note near the detail stating the size and type of splice bolts and nuts

### 5.4.9.3 Longitudinal Section

For steel structures, a Longitudinal Section diagram must be included somewhere in the plans. This diagram may be placed on the Erection Plan Sheet, Splice Detail Sheet or as part of another detail sheet. The Longitudinal Section illustrates an elevation view of the girder and bearing placement at each bent. When preparing the Longitudinal Section diagram, consider the following:

1. Illustration. Only illustrate the portion of the girder at each end bearing, each intermediate bent and at the field splices. There is no need to show the intermediate portions of the beam. The diagram does not need to be drawn to scale but, instead, the vertical scale may be exaggerated to illustrate the necessary details.
2. Dimensions. Include the span dimensions from each bent centerline. Also, include the dimension from the end bearing to the field splice and between each field splice.
3. Working Points. Show the working point location. The working point is the point at the top of the web through a vertical line at the centerline of the bearing or centerline of splice. See Structure Manual Volume II, Figures 18.5A, 18.5B, and 18.5C for additional information.

4. Offset Dimension. At each bearing, note the offset distance between the working point and a line perpendicular to the girder flanges. The offset distance is measured in to 1/16 in. (1 mm). The perpendicular line and the vertical line should intersect at the top of the bearing and at the centerline of the bearing.
5. String Line Slope. If the structure is not on a vertical curve, show the string line slope at the top of top flange between the working points. For a welded plate girder, the string line is usually shown from centerline of bearing to centerline of bearing. For rolled sections, the string line is from field splice to field splice, or along field sections. The flange is typically shown as a dashed line. Note the string line slope and direction between each working point to 0.0001.

### 5.4.9.4 Diaphragm Details

For concrete structures, the Diaphragm Details are typically included in the Standard Drawings. For steel structures, a separate detail sheet is typically included in the plans. When preparing Diaphragm Details, consider the following:

1. Elevation View. Diaphragm Details are typically shown as a cross-section view of the superstructure. Note that it will not be necessary to show the slab portion in the detail. Because of the similarity between diaphragms, views are typically only provided for the end diaphragms, diaphragms at intermediate bents and/or diaphragms between bents. Where the diaphragms are essentially symmetrical around the roadway centerline, the designer may elect to combine two views onto one cross-section view.
2. Steel Shapes. In all views and details, note the steel shapes and sizes for the girders,



stiffener plates, diaphragms, jacking plates, etc.

3. Dimensions. In the Elevation View, note the following dimensions:

- a. the spacing between the centerlines of the girder;
- b. the spacing between intermediate girders adjacent to the roadway centerline and the roadway centerline;
- c. the placement of the diaphragm with respect to the top or bottom of the girder; and
- d. location of all diaphragm stiffeners, jacking plates, etc.

4. Attachments. All attachments of the various components should be clearly noted in the Elevation View. If this is not practical, provide separate details on the sheet to show bolt locations, welding criteria, grinding criteria, etc.

5. Notes. Notes may be added to the sheet to indicate:

- a. location and placement of diaphragms,
- b. diameter of bolt holes,
- c. bolt and nut types and sizes, and
- d. welding details.

#### 5.4.9.5 Shoe and Joint Details

Most projects will require a separate sheet for the Shoe and Joint Details. However, for simple designs, these details may be added to another miscellaneous detail sheet. When preparing the Shoe Detail Sheet, consider the following:

1. Details. A Shoe Detail Sheet may contain one or more of the following details:

- a. Fixed Shoe Details, including end and side views;
- b. Expansion Shoe Details, including end and side views;
- c. Sole Plate Bevel Details;
- d. Elastomeric Bearing Pad Details;
- e. Expansion Joint Details;
- f. Anchor Bolt; and/or
- g. other joint details.

2. Steel Shapes. Note the size, shape and placement of the various steel elements in all views.

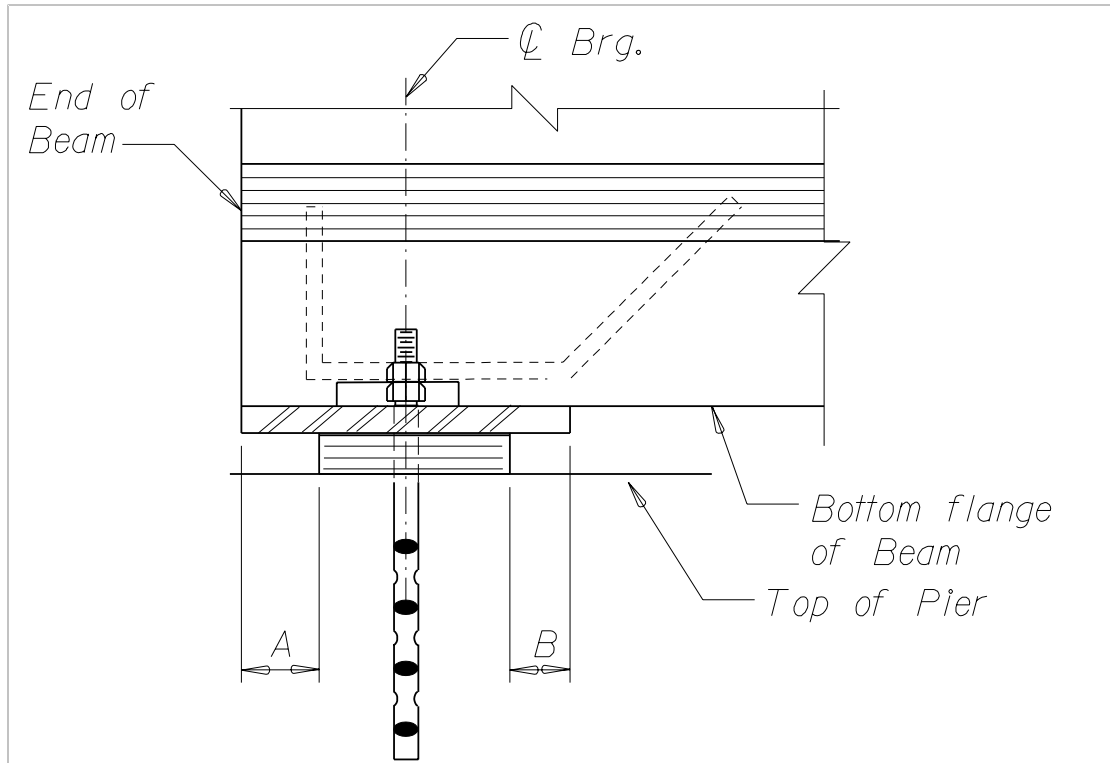
3. Dimensions. Note all necessary dimensions to allow the contractor to construct the shoe and joint structural elements.

4. Attachments. Note all welding sizes and criteria. For the anchor bolts, note the bolt size, hole diameter and nut sizes in all views.

5. Table of Expansion Shoe Dimensions. Where an expansion joint is used, a Table of Expansion is required to properly determine the location of the elastomeric pad with respect to the sole plate and outside temperature. Figure 5.4K illustrates a sample Table of Expansion Shoe Dimensions. Select the temperatures in the table using 5°C increments. Show the “A” and “B” dimensions rounded to 1/16 in. (1 mm). The location of the A” and “B” dimensions are shown in the Expansion Shoe Detail figure.

TABLE OF MOVEMENTS						
Location	Dimension	Temperature ° F				Temperature change Δ For 1/8" Adjustment (° F)
		- 40	35	60	110	
Pier 2	A	2 3/4"	3 1/2"	3 3/4"	4 1/4"	12° F
Span 2	B	4 1/4"	3 1/2"	3 1/4"	2 3/4"	
Pier 5	A	1 3/4"	3 1/2"	4"	5 1/4"	5° F
Span 4	B	5 1/4"	3 1/2"	3"	1 3/4"	

EXPANSION SHOE TABLE OF MOVEMENTS							
Location	Dimension	Temperature (°C)					Temperature Δ For 3 mm Adjustment
		-46	-3	15	30	40	
Bent 2	A	70	45	34	26	20	5.1
Span 2	B	20	45	56	64	70	
Bent 4	A	64	43	34	27	22	6.1
Span 3	B	21	42	51	58	63	



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SAMPLE TABLE OF EXPANSION SHOE DIMENSIONS

Figure 5.4J

#### 5.4.9.6 Bridge Rail

For non-pedestrian bridges, the bridge rail or barrier is typically provided as a Standard Drawing. For structures which accommodate pedestrians or non-standard rail designs, include a separate detail sheet for the bridge rail design; see Chapter Fifteen. The bridge rail may be a pedestrian fence, metal beam rail, bicycle rail, concrete barrier or other design. Only include the details for the bridge rail on this sheet. Bridge rail detail sheets typically will show:

- a. a partial elevation view of the rail,
- b. cross-section view of how the rail attaches to the superstructure,
- c. attachment details,
- d. rail fabrication details,
- e. splicing details, and
- f. necessary construction notes.

At the end of the structure plans, include copies of all applicable Standard Drawings. If the detail shown in the Standard Drawing is revised, do not include the revised drawing as a standard. Instead, include the detail on the appropriate detail sheet. Copies of the Standard Drawings are provided in the **Montana Structures Manual** and in the **Standard Bridge Details and Notes**. Section 8.1.3 provides additional guidance on the publication of the Standard Drawings.

#### 5.4.9.7 Miscellaneous Details

There are numerous other details that may be shown within a set of structure plans. Include all the necessary details, dimensions, notes, etc., on the sheet to allow the contractor to construct the item. Do not mix the typical structural design details (e.g., Splice Details, Longitudinal Section) with these miscellaneous details on the same sheet. Some of the miscellaneous details may include:

- a. luminaire supports,
- b. utility attachments,
- c. retaining walls,
- d. stairway details, and/or
- e. sign supports.

#### 5.4.10 Standard Drawings

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## Chapter Six

# QUANTITY ESTIMATES

In addition to preparing clear and concise construction plans, as described in Chapter Five, the designer must compile an accurate estimate of the project construction quantities. This information leads directly to the Engineer's Estimate, which combines the computed quantities of work and the estimated unit bid prices. An accurate estimate of quantities is critical to prospective contractors interested in submitting a bid on the project. Chapter Six presents detailed information on estimating quantities for structural projects.

### 6.1 GENERAL

#### 6.1.1 Guidelines for Preparing Quantity Estimates

When preparing quantity estimates, the designer should consider the following guidelines:

1. Specifications. Cross check all items against the **Standard Specifications** and the Supplemental Specifications to ensure that the appropriate pay items, methods of measurement and basis of payment are used.
2. Computations. Prepare a separate computation sheet for each item used on the project. Include all computation sheets in the project file.
3. Rounding. Round the quantity of any item provided in the Estimated Bridge Plan Quantities Table on the Q-sheet according to the criteria in Figure 6.1A. The computation sheet should be calculated to one more decimal place than that noted in Figure 6.1A. Note any required rounding of raw

estimates on the computation sheets. Unless stated otherwise, do not round the calculations until the value is incorporated onto the Q-sheet.

4. Significant Digits. Perform quantity calculations with careful regard to the implied correspondence between the accuracy of the data and the given number of digits. In all calculations, the number of significant digits retained should be such that the accuracy is neither sacrificed nor exaggerated. Use the following rules to determine the appropriate number of significant digits:

- a. Number of Digits. Any digit that is necessary to define the specific value or quantity is considered significant. When a measurement is taken, this measurement may be recorded as 157, this number has three significant digits. If the measurement had been made to the nearest 0.1, the measurement may have been 157.4; this number has four significant digits.

Zero may be used to indicate either a specific value, like any other digit, or a number's order of magnitude. A measurement rounded to thousands, may be 120 000. The three left-hand digits of this number are significant; each measures a value. The three right-hand digits are zeros which merely indicate the order of magnitude of the number rounded to the nearest thousand. The identification of significant digits is only possible through

Item	English		Metric	
	Measured Unit	Rounding Criteria	Measured Unit.	Rounding Criteria
Structure Excavation Type “___”		5	5 cubic meter increments, m <sup>3</sup>	5
Class “___” Concrete	cubic yard, y <sup>3</sup>	0.1	cubic meter, m <sup>3</sup>	0.1
Reinforcement Steel	pound, lb	1	kilogram, kg	1
Structural Steel	pound, lb	1.00	Lump Sum	1.00
Bridge Drains	each, ea	1	each, ea	1
Steel Bridge Rail - Type 101	foot, ft	0.1	meter, m	0.01
Modified Traffic Rail	foot, ft	0.1	meter, m	0.01
Handrail	foot, ft	0.1	meter, m	0.01
Pedestrian Rail	foot, ft	0.1	meter, m	0.01
Piles - Furnishing	foot, ft	1	meter, m	0.1
Piles - Driving	foot, ft	1	meter, m	0.1
Dynamic Load Tests	each, ea	1	Each, ea	1
Pile – Drill and socket	foot, ft	1	meter, m	0.1
Pile – Prebore Holes	foot, ft	1	meter, m	0.1
Prestressed Concrete Beams - Type “_____”	foot, ft	0.1	meter, m	0.1
Drainage System	Lump Sum, LS	1.00	Lump Sum, LS	1.00
Shoring and Cribbs	Lump Sum, LS	1.00	Lump Sum, LS	1.00
Guard Fence	foot, ft	0.1	meter, m	0.01
Remove Structure	Lump Sum, LS	1.00	Lump Sum, LS	1.00
Expansion Joint	foot, ft	0.1	m	0.01
Transverse Deck Grooving	square yard, yd <sup>2</sup>		square meter, m <sup>2</sup>	
Pile Driving Points or Cutting Shoes	each, ea	1	each, ea	1
Remove Deck	square yard, yd <sup>2</sup>	0.1	square meter, m <sup>2</sup>	0.1
Bridge Deck Hydrodemolition	square yard, yd <sup>2</sup>	0.1	square meter, m <sup>2</sup>	0.1
Class A Bridge Deck Repair	square yard, yd <sup>2</sup>	0.1	square meter, m <sup>2</sup>	0.1
Class B Bridge Deck Repair	square yard, yd <sup>2</sup>	0.1	square meter, m <sup>2</sup>	0.1

### QUANTITIES TABLE ROUNDING CRITERIA

Figure 6.1A

knowledge of the circumstances. For example, the number 1000 may be rounded from 965, in which case only one zero is significant, or it may be rounded from 999.7, in which case all three zeros are significant

- b. **Addition and Subtraction.** When adding and subtracting quantities, do not express the answer's significant digits any further to the right than occurs in the least precise number. The following illustrates this rule:

Consider the addition of three numbers drawn from three sources, the first of which reported data in millions, the second in thousands, and the third in units:

$$\begin{array}{r} 163\,000\,000 \\ 217\,885\,000 \\ +\,95\,432\,768 \\ \hline 476\,317\,768 \end{array}$$

The total should be rounded to 476 000 000; i.e. in millions.

- c. **Multiplication and Division.** Do not express the product or quotient for multiplication and division calculations with any more significant digits than are used in the calculations. The following illustrates this rule:

**Multiplication:**

$$113.2 \times 1.43 = 161.876; \text{ round to } 161.9$$

**Division:**

$$113.2 \div 1.43 = 79.16; \text{ round to } 79.2$$

5. **Multiple Estimates.** Some projects will require two or more estimates for work conducted under various financing

arrangements. For projects requiring quantity divisions, organize the Quantities Table as discussed in Section 5.4.1.3.

6. **Final Bridge Cost Estimate.** Use only the total values from the Quantities Table to develop the Final Bridge Cost Estimate. All items described in the plans that will be included in the cost estimate must be shown in the Quantities Table. Chapter Seven provides the Department criteria for preparing construction cost estimates. The Final Bridge Cost Estimate is utilized by the Board of Review and the Contract Plans Section in their preparation of the final Engineer's Estimate.

### 6.1.2 Units of Measurement

Report the quantity estimates in the quantities table for all contract bid items consistent with the terms and units of measurement presented in the **Standard Specifications**. Figure 6.1A illustrates typical rounding criteria that should be used for the quantities table on the Q-sheet.

### 6.1.3 Item Codes

Each item used for measurement and payment in construction is identified by a 9-digit number with a title and description. These numbers are used by the Department's Construction Management System for tracking the project through construction. Note that the first three digits of the item number are coordinated with the **Standard Specifications**. For example, Item #555010100 "Reinforcing Steel" is referenced to Section 555 "Reinforcing Steel" of the **Standard Specifications**.

The Contract Plans Section is responsible for numbering and naming the various items used in construction. Contact the Contract Plans Section to obtain a copy of the official item list. Only

use the official name and description of the item on the Quantities Sheet, in special provisions, plan notes, etc. Submit all proposed changes or additions to this list, through the Bridge Design Engineer, to the Contract Plans Section.

#### **6.1.4 Computer Estimates**

The Department uses several computer programs to estimate structural quantities. Round the output quantities from these programs according to Figure 6.1A and place them in the Quantities Table as discussed in Section 5.4.1.3. For additional guidance on these and other estimating programs, the designer should contact the design unit supervisor.



## 6.2 LUMP-SUM ITEMS

### 6.2.1 General

The lump sum items listed in Figure 6.1A are always bid lump sum. For other bid items, only use lump sum where the scope for the item is clearly defined and the amount of work has a minimal chance of changing during construction. Including an item of work in another item is only appropriate where the scope of work for each item is clearly defined and the chance of the quantity of either item changing is minimal. Where practical, list separately the quantities that comprise the lump sum item of work. The list should note that the separate “quantities are for estimating purposes only.” Provide a clear definition of work for each item whether it is bid by the unit, included in the cost of other items or bid lump sum. Where there is a significant chance of quantity change, the work must be bid by the unit. Where lump sum items are used, the total quantity for the project should always equal one.

The following sections discuss the procedures that should be used to determine the cost estimate for some of the typical lump sum items used on the project.

### 6.2.2 Structural Steel

The cost estimate for structural steel is based on the weight of all the steel components in the structure. Include the weight of all beams, plates, diaphragms, stiffeners, bearing plates, bolts, shear studs, etc., in the estimate. Note that reinforcing bars are estimated and bid separately.

Calculate the weight of the steel using the following guidelines:

1. Rolled steel has a unit weight of 490 lb/ft<sup>3</sup>.
2. Weld metal quantities are considered

negligible in relation to overall steel quantities and are not calculated.

3. For steel that is to be painted, add 0.4% of the computed weight of the metal as an allowance for shop paint.
4. Compute the weight of rolled shapes and plates based on their nominal size as shown on the approved shop drawings. Calculate this weight using the minimum rectangular dimensions the shape can be cut from for the plates and the overall length for structural shapes. Make no deductions for copes, slips, sheared edges, punching, borings, milling or planing. For plates only, increase the calculated weight by 1.5%. Plate weights for any particular lot vary due to rolling tolerances allowed in plate thickness. Table 2 or A1.2 (metric) for ASTM A6 show these values. For simplicity, the bureau adjusts the calculated weight by 1.5% to soften the potential impact of the purchased weight being underestimated.
5. For plate girder webs that are cambered, the calculated weight will be taken as that of the material from which the web can be cut.
6. Measure bolts, nuts and washers for payment on the basis of computed weight as called out in the **AISC Manual of Steel Construction**.
7. Do not include Direct Tension Indicators (DTI's) masses in structural steel quantities.
8. Round the total to the nearest pound.

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## Chapter Seven

# CONSTRUCTION COST ESTIMATES

Chapter Six presents the Department's procedures for the preparation of quantity summaries. The Department and contractors use these quantities to determine the estimated cost for construction of the project. Chapter Seven provides information on the various preconstruction cost estimates required during project development and the procedures for developing these estimates.

### 7.1 PRELIMINARY PROJECT ESTIMATES

During project development, several cost estimates are prepared to determine and refine the expected project construction costs. The Transportation Planning Division uses these estimates to determine program balance and to ensure that sufficient funds are available for construction. The following Sections present the various cost estimates that are prepared during project development and who is responsible for preparing each estimate. Figure 7.1A provides the recommended distribution list for each of these cost estimates.

#### 7.1.1 Project Programming

The District Office is responsible for nominating projects to be included on the Department's Program of Projects. The District will request the Bridge Bureau to provide an approximate cost estimate for any structures on the project. The Bridge Area Engineer will be responsible for preparing this estimate. This estimate is typically developed based on the area of the proposed bridge deck, the type of structure (e.g.,

steel, concrete, wood), recent similar projects in the geographic area and engineering judgment.

#### 7.1.2 Bridge Managed Projects

For bridge managed projects, cost estimates are generally provided at the following project stages:

1. Preliminary Field Review Report. The Bridge Area Engineer is responsible for determining the construction cost estimate at this project stage. The cost estimate typically will be developed based on the area of the proposed bridge deck, the type of structure, recent similar projects in the geographic area and engineering judgment. The cost estimate should include all project elements from all units including road items, traffic items, etc. Assume an inflation factor of 3% per year for projected costs. Include the cost estimate in the Preliminary Field Review Report as discussed in Section 4.1.1.2.
2. Scope-of-Work Report. The Bridge Area Engineer should update the project programming estimate in a similar manner as for the Preliminary Field Review Report. Include the latest estimate in the Scope-of-Work Report as discussed in Section 4.1.2.2.
3. Plan-in-Hand. The Bridge Area Engineer should update the total project estimate. Prepare the estimate in a similar manner as for the Preliminary Field Review estimate. Refer to Figure 7.1A for distribution.

<b>Distribution</b>	<b>Programming Project</b>	<b>Preliminary Field Review</b>	<b>Scope of Work</b>	<b>Project Scope Changes</b>	<b>Plan -in- Hand</b>	<b>Bridge Final Estimate</b>
Transportation Planning Division	X	X	X	X		
Fiscal Programming	X	X	X	X	X	X
District Administrator(s)	X	X	X	X	X	
Engineering Management Section — Engineering Division	X	X	X	X	X	X
Contract Plans Section						X
Project Files	X	X	X	X	X	X

**COST ESTIMATE DISTRIBUTION**  
**Figure 7.1A**

4. Project Scope Changes. Whenever the scope of the project changes, the Bridge Area Engineer will be responsible for developing a new construction cost estimate. Estimates for scope of work changes are typically based on the same procedures as for the Preliminary Field Review Report. Refer to Figure 7.1A for distribution.

### **7.1.3 Road Design Managed Projects**

Through various stages of project development, the Bridge Bureau will be responsible for providing the Road Design Section with a cost estimate of the structural elements included on a road design project. The Bridge Bureau is responsible for providing the following information:

1. Alignment and Grade Review. At this project stage, the Bridge Area Engineer is responsible for providing the road designer with a rough estimate for structural elements. Develop this estimate based on the area of the proposed bridge deck, the type of structure (e.g., steel, concrete, wood), recent similar projects in the geographic area and engineering judgment.
2. Scope-of-Work Report. If an alignment and grade review was not conducted, the Bridge Area Engineer will be responsible for providing the road designer with a rough estimate for structural elements. If an estimate was prepared for the alignment and grade review, the Bridge Area Engineer generally will not be required to update the estimate for the Scope-of-Work Report.
3. Plan-in-Hand. The Bridge Area Engineer is responsible for providing the road designer with a rough estimate for structural elements. Review the Scope-of-Work Report estimate to determine if it needs to be

updated. If so, prepare a new estimate in the same manner as for the Alignment and Grade Review estimate.

4. Project Scope Changes. Whenever the scope of the project changes, the Bridge Area Engineer must provide the road designer with a new cost estimate. Develop this estimate in the same manner as for the Alignment and Grade Review estimate.

### **7.1.4 Final Project Estimate**

The final project estimate is developed based on the estimated quantities and unit prices. The bridge design crew will prepare this estimate. The estimate is forwarded to the Bridge Engineer for approval.

### **7.1.5 Engineer's Estimate**

Once the final project estimate has been approved by the Bridge Engineer, forward the final project estimate to the Contract Plan Section so that they can prepare the Engineer's Estimate. The Contract Plans Section will be responsible for collecting and distributing to the Board of Review the final cost estimates from all Bureaus. The Board of Review includes representatives from the Construction Bureau, Bridge Bureau, Road Design Section, Pavement Design Section and Contract Plans Section. The Board of Review will review and may adjust the major bid item prices as deemed necessary. The Contract Plans Section will review all other bid prices and prepare the Engineer's Estimate.

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## 7.2 FINAL PROJECT ESTIMATES

### 7.2.1 General

When preparing a detailed cost estimate, the designer should note the following:

1. Funding Splits. Some projects may have multiple funding sources. For example, the roadway approaches may be funded separately under their own project coding from the structure portion of the project. Rivers are often county boundary lines, bridges spanning these locations have project funding splits to each of the counties. For these types of projects, and similar situations, separate cost estimates are required for each funding source based on the quantities within that particular funding source. The Fiscal Program Section will provide the locations of the funding splits to the designer.
2. Estimate Form. Use the Bridge Excel Estimate Form to prepare the cost estimate. The Excel program accesses a secure database of cost data which is periodically updated by a bridge designated representative. The designer is expected to review the database costs and change them as required on a project specific basis.
3. Quantities. In general, show all estimated bridge plan quantities on the Bridge Title Sheet. Use these quantity totals to determine the final cost estimate. The plan checker should note that some quantities may be shown elsewhere within the plans. The plan checker must be careful not to double count these quantities. See Chapter Six for information on how to develop quantity summaries.
4. Design Estimates. During the design stages, the Bridge Area Engineer will be required to provide general cost estimates for the project. These estimates are typically determined based on recent similar projects, area of the bridge deck, type of structure and engineering judgment.
5. Unit Prices. The final cost estimate is determined using the estimated quantities and unit prices. The design engineer will list the quantity items from the Title Sheet and the appropriate unit prices in the computer program. Average unit bid prices are provided by the Contract Plans Section twice a year. The designated individual with access to the database is responsible for inserting these prices into the program. However, prior to using these unit prices, the plan checker should review the prices based on geographic location and similar, recent projects.
6. Quantity Descriptions. Only use the quantity descriptions as provided in the average unit bid prices for the quantity descriptions on the estimate form.
7. Work Type Codes. On each estimate, include the work type code (X \_ \_ \_). The work type code is determined as follows:
  - a. The first digit “X” indicates the bridge class.
  - b. The second digit indicates the type of crossing. These are broken down into the following categories:
    - X0-- Highway over waterway
    - X1-- Highway over railroad
    - X2-- Highway over highway
    - X3-- Highway over waterway and railroad
    - X4-- Highway over waterway and highway

- X5-- Highway over railroad and high-way
- X6-- Highway under railroad
- X7-- Highway under highway
- X8-- Highway under railroad and high-way
- X9-- Other combinations including highway over waterway, railroad and highway; 3 and 4 level grade separations and miscellaneous crossings.

- c. The third digit identifies the material type for the principal supporting members of the span. These are broken down into the following categories:

- X-0- Timber
- X-1- Masonry
- X-2- Concrete, not prestressed
- X-3- Steel
- X-4- Steel and concrete
- X-5- Timber and steel
- X-6- Timber and concrete
- X-7- Composite steel and concrete
- X-8- Concrete, prestressed
- X-9- Aluminum

- d. The fourth digit identifies the span type (use the main span if the bridge is comprised of 2 or more span types). These are broken down into the following categories:

- X--0 Slab
- X--1 Girder
- X--2 Truss (except cantilever)
- X--3 Rigid frame
- X--4 Arch
- X--5 Cantilever truss
- X--6 Movable
- X--7 Suspension
- X--8 Box culvert of bridge length

- e. For miscellaneous structures, the following codes apply:

- X999 Highway tunnel
- X009 Pedestrian overpass or underpass

8. Contract Duration. A recommended contract duration is among the information provided when PS&E (Plans, Specifications, and Estimate) documents are transmitted to the Contract Plans Section. The contract duration has historically been chosen by the Bridge Engineer, Bridge Design Engineer, or Bridge Area Engineer based on an intuitive grasp of the project size and project complexity. For the most part the values selected have generated little or no controversy, but on occasion the contract duration is contested by contractors. This guidance is intended to fulfill a need for a more rational and documented procedure.

The individual preparing the Engineer's Estimate is responsible for determining appropriate contract duration. Bridge construction duration is based on work days. Two methods are presented:

- a. Construction Sequencing Method.

This method is a rational method that to some degree mimics the contractor operation and would probably hold up under close scrutiny and work well for new, "clean" construction. The method may not be suitable for deck overlays and other types of rehabilitation projects where a lot depends on the expertise and ingenuity of the contractor.

In this method you visualize how the project will be built. No attempt has been made to account for shop drawing reviews and fabrication.



Chargeable time starts when the contractor receives the “Notice to Proceed.” This document is issued once the contract has been signed. The “Notice to Proceed” is usually issued about 6 weeks after a contract is awarded. There is usually a Preconstruction Conference about the time the contractor gets the “Notice to Proceed” at which time introductions are made and a tentative work schedule is given to the state.

If the contractor makes a reasonable effort to obtain permits from the resource agencies in a timely manner, the Department does not charge time against the project until he receives them. Most projects take from 30 to 60 days to receive the permits.

As a guide use the following construction sequence and durations for specific construction elements.

- If the contractor gets the permits but there are in-stream work restrictions then only a limited amount of work that can occur. The contractor would be charged contract days until he reached a point in the project where no further work could be done until in-stream or other work restrictions no longer apply.
- Working days are only charged as identified in Section 108.07.2 of the Standard Specifications

The following are estimates for the contract time for typical bridge construction activities:

- Work Bridge and site work – 10 days. This is work just to get up and running.
- Cofferdam – 5 days to get a cofferdam enclosed and excavated to plan grade. Additional cofferdams would add 5 days each.
- Piling Testing – 2 days per test to get pile driver operational, move machine around and allow state inspectors to mark and observe pile installation.
- Service piles – 4 days to get up to 10 piles installed. If there are more than 10 service piles assume *additional* piles go in at 4 per day.
- Drilled Shafts – Assume submittals or approvals do not delay the project. 4 days per drilled shaft for nominal 6 ft (2 meter) shafts not extending a great depth into formation material.
- Form End and Intermediate Bent Caps – 3 days each.
- Cast and Cure Caps – 15 days for the project. Because caps need to be at or above 80% of the design  $f'_c$  (Standard Specifications – Table 552-1) there is an inherent delay to the project between the time the last cap is cast and the beams can be set.
- Set Beams or Girders – 1 day per span.
- Adjust Steel Girders to Grade – 3 days. For bridges longer than 400 ft (120 meters) add 1 day per 130 ft (40 meters).

- HS bolting – 3 days per line of splices (not per line of girder)
- Forming deck and placing steel – 20 days up to 300 ft (90 meters). For longer bridges add 1 day for every additional 15 ft (5 meters). Increase duration 15% for flared projects.
- Cast Deck – 1 day for bridge up to 300 ft (90 meters). For longer bridge use 2 days.
- Wet Cure and seal – 28 days.
- Install rail and sawcut – 10 days if it's a T101. 20 for a barrier rail.
- Cleanup – 5 days per project.
- Round to nearest 10 days.

9. Contract Value Method. Another way to estimate how long it will take a contractor to complete a project is to assume that a contractor's crew on the long haul generates about the same billable revenue for the contractor day in and day out. The bigger the project, the longer it will take to do it, but it isn't linear because on large jobs there will be a bigger crew and more equipment resources.

Looking at "Bridge Only" items as reported by the FHWA (this information is extractable from the Engineer's Estimate. Do not include mobilization, traffic, erosion control, bridge survey or Construction Engineering) a general trend line shows a correlation between how big a project is and how long we thought it would take to get it done. Curve fitting subroutines quantify that relationship as approximately:

$$\text{Contract Duration} = 38 * \ln(x) - 100$$

Where "x" is the value of the bridge items in thousands of dollars (i.e. enter 500,000 as 500)

Round to the nearest 10 days

Any number of considerations could drive the recommended value from the number calculated. Among those considerations are:

- Desire to complete in a single construction season (before the next season). A construction season runs from April 16 to November 15 and has 150 chargeable days. Some work days are not chargeable if the contractor cannot work because of weather or if the contractor has applied for, but is waiting for, permits. Any work that the contractor can perform from November 16 to April 15 is not charged to the allotted work days. When determining contract duration do not assume any contractor operations between November 16 and April 15.
- Consider phase construction which at times effectively forces the contractor to construct two or more bridges, one after the other.
- Work restrictions imposed by resource agencies.
- Repair projects that have a very high priority.

10. Lump-Sum Items. Only use lump-sum items where the scope of work for the item is clearly defined and the amount of work has a minimal chance of changing during construction. Section 6.2 provides additional information on how to treat lump-sum quantities. In determining the unit price

for lump-sum items, the designer should consider the following:

- a. Mobilization. Mobilization is a lump-sum bid item. The contractor's bid on mobilization depends upon several factors (e.g., remoteness of site, proximity to other operations by the contractor, the amount of equipment that will have to be transported to the project site). Mobilization is usually estimated by the engineer to be at least 15% of the total cost of the construction items. A higher percentage is appropriate for smaller projects. To determine the cost of the contractor's work bridge, see Section 7.2.4. The calculated figure for mobilization is usually rounded to the nearest \$1000.
- b. Traffic Control. The District will determine the appropriate amount for traffic control.
- c. Other Items. Most lump-sum bid items can be divided into individual parts for estimating purposes. For example, add up the mass of the various steel components and multiply this by the unit price per kilogram to determine the lump-sum amount. For removal of structures, the cost can be determined based on the area of the structure and similar projects, see Section 7.2.3. Once the elements have been segregated, use engineering judgment to determine the appropriate cost for the lump-sum bid item on the project.

11. Contingencies and Construction Engineering. In developing cost estimates, the designer must assume a cost for construction contingencies and construction engineering. For preliminary

estimates, calculate contingencies assuming 10% of all construction items. Do not include any amount for contingencies in the final estimate. Construction engineering is calculated assuming 15% of all construction items, including the contingency amount. Construction engineering is included in the final estimate. The Board of Review will set the final construction engineering cost.

12. Approval and Distribution. Submit the final construction cost estimates to the Bridge Engineer for approval. After receiving the Bridge Engineer's approval, include the final estimate with the contract documents when the plans are forwarded to the Contract Plans Section. Also, distribute copies of the cost estimate to the units or individuals as shown in Figure 7.1A and the project file.

### 7.2.2 Shoring and Cribbs

The cost for shoring and cribs is a function of the size and depth of the anticipated cofferdam. The bid item is a lump-sum item, but the cost is estimated as shown in Figure 7.2A. The estimated cost is based on a formula developed from historical data. The basic algorithm is a second order equation that reflects the added difficulties for handling and installing longer sheet piling, additional bracing rings and additional pumping capacity to dewater the deeper excavations. Round the value calculated up to the next \$5000 increment.

**7.2.3 Remove Structures**

For “routine” types of structure removal, use the following guidelines to estimate removal costs:

1. Timber – without salvage use \$225/ft (\$700/meter) of length, but not less than \$7000.
2. Timber – with salvage use \$450/ft (\$1400/meter) of length.
3. Steel Girders – use \$225/ft (\$700/meter) or length.
4. Truss – without salvage, \$225/ft (\$700/meter) of length plus \$4000 for each concrete substructure unit.
5. Truss – with salvage, \$450/ft (\$1400/meter) of length plus \$4000 for each concrete substructure unit.
6. Concrete – without salvage, \$225/ft (\$700/meter) of length plus \$4000 for each concrete substructure unit.

Adjust the estimate to account for additional factors that may need to be considered (e.g., bridges over railroads, high bridges, bridges near sensitive areas).

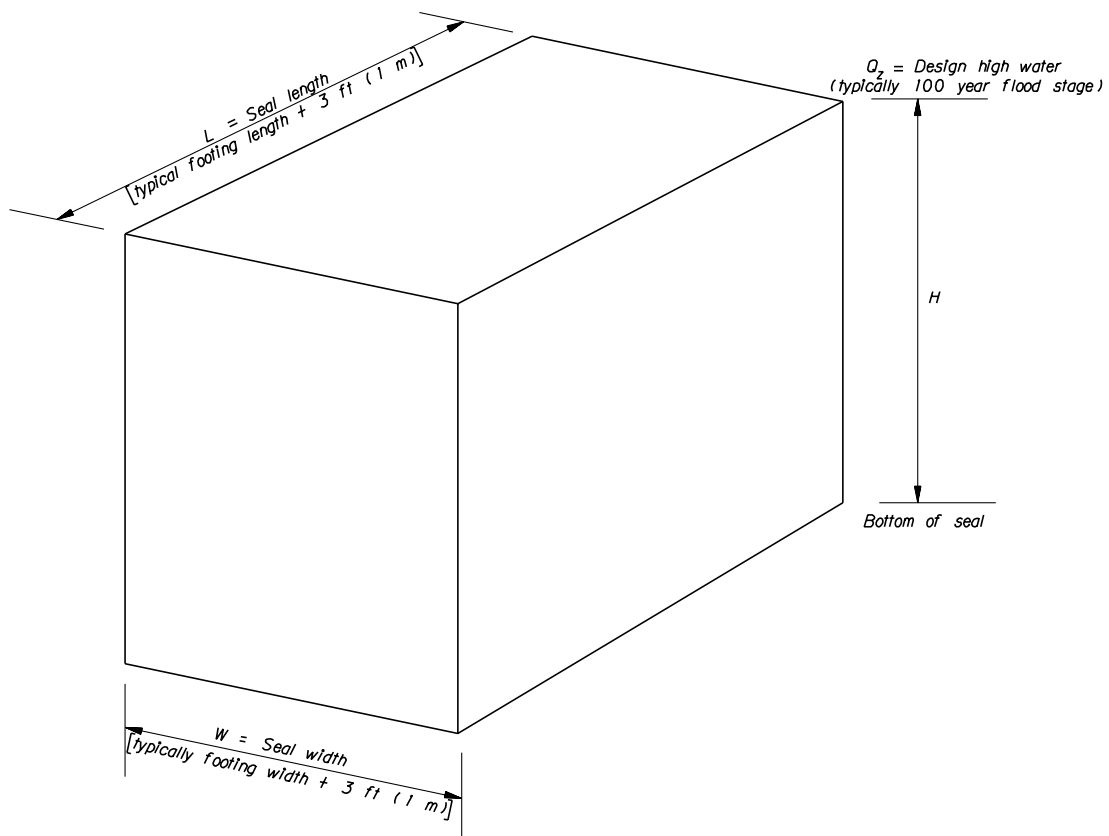
**7.2.4 Work Bridges**

The final project estimate does not include a separate item for work bridges. Their cost is included in the lump-sum cost for “Mobilization.” When you use the estimate spreadsheet, mobilization is usually calculated as a percentage of the overall contract. When work bridges are anticipated, estimate the length, plus any laterals that may be required, and apply a cost of \$375/ft (\$1200/meter). This amount is to be added to the amount for

mobilization by placing the value in the appropriate cell of the spreadsheet.

**7.2.5 Detour Bridges**

If detour bridges are required, the cost is estimated in the same manner as the cost of the contractor’s work bridge; see Section 7.2.4. The cost of the detour bridge is usually mentioned in the plans transmittal letter and not included on the Bridge Quantities Sheet.



Cost per unit square area of cofferdam face:

$$\text{Cost / ft}^2: C = 0.06H^2 - 1.27H + 32.52$$

$$\text{Cost / m}^2: C = 7H^2 - 45H + 350$$

$$\text{Wetted perimeter: } P = 2WLH$$

$$\text{Total Cofferdam Cost} = C \times P$$

## SHORING AND CRIB ESTIMATES

Figure 7.2

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## Chapter Eight

# CONTRACT DOCUMENTS

Chapter Five presents the Department's procedures for the preparation of construction plans. In addition, contractors, material suppliers, and Department personnel assigned to supervise and inspect the construction of the project use the Standard Specifications for Road and Bridge Construction (Standard Specifications), Supplemental Specifications, Special Provisions and the MDT Bridge Standard Drawings to assist them in the project design and construction. Chapter Eight describes the purpose of these other documents. Chapter Eight also presents the guidelines for preparing Special Provisions.

### 8.1 GENERAL

#### 8.1.1 Hierarchy of Importance

The Standard Specifications, Supplemental Specifications, Special Provisions and construction plans all are essential parts of the contract. They are intended to complement each other and are used to describe and provide complete instructions for the work to be accomplished. If a discrepancy does exist between these documents, the following presents the hierarchy of importance among them:

1. "Question & Answer Forum" Information
2. Special Provisions
3. Plans
  - a. Plan dimensions
  - b. Calculated dimensions
  - c. Scaled dimensions
4. Supplemental Specifications
5. Standard Specifications
6. Supplemental Detailed Drawings
7. Detailed Drawings

## **8.1.2 Specifications**

### **8.1.2.1 Standard Specifications for Road and Bridge Construction**

The Standard Specifications for Road and Bridge Construction (Standard Specifications) are the standards adopted by the Department for work methods and materials that are used for construction. The Standard Specifications are intended for general use on all projects. They provide the Department's criteria for:

- a. bidding,
- b. awarding of the contract,
- c. the contractor's duties,
- d. controlling the material quality,
- e. the contractor and the Department's legal requirements,
- f. executing the contract, and
- g. measuring and paying for contract items.

The Standard Specifications are published in book form and are typically updated and reprinted every five to seven years. Copies of the Standard Specifications can be obtained from the MDT Contract Plans Section.

All proposed changes to the Standard Specifications must be forwarded to the Construction Bureau for evaluation and action.

### **8.1.2.2 Supplemental Specifications**

Supplemental Specifications are additions, deletions and/or revisions to the Standard Specifications which have been adopted by the Department since the last printing of the Standard Specifications. The intention is that they will be incorporated into the Standard Specifications at the next revision. As indicated in Section 8.1.1, Supplemental Specifications supersede the Standard Specifications. Complete sets of Supplemental Specifications

are added to the contract documents for all projects and are intended for general use.

Supplemental Specifications are periodically updated and are available on the MDT Internet site.

All proposed changes to the Supplemental Specifications must be forwarded to the Construction Bureau for evaluation and action.

### **8.1.2.3 Special Provisions**

Special Provisions are additions or revisions to the Standard Specifications and the Supplemental Specifications setting forth conditions and requirements for a special situation on a particular project. Special Provisions are included in the contract documents for that project and are not intended for general use. Special Provisions supersede all other contract documents. They are prepared by the designer for inclusion into the project documents. Section 8.2 discusses guidelines for preparing Special Provisions.

Standard Special Provisions are special provisions which are commonly used on many projects. The Bridge Bureau have compiled a library of Standard Special Provisions for bridge items. This library is routinely updated and sent to the designers. The designer is responsible for determining which Standard Special Provisions should be included in the contract document.

The designer must ensure that the Standard Special Provisions are applicable for that particular project. If the Special Provision is not applicable or must be revised, the designer will be responsible for making these revisions.

## **8.1.3 Standard Drawings**

### **8.1.3.1 MDT Bridge Standard Drawings**



The MDT Bridge Standard Drawings provide details on various bridge elements that are consistent from project to project (e.g., prestressed concrete beams, slab details, diaphragm details, bridge rails). Copies of the MDT Bridge Standard Drawings are provided in the Standard Bridge Details and Notes Manual, or they can be obtained from the Bridge Bureau. In addition, all drawings are provided on the Department's network. Users can review the drawings through the Department's central computer. However, the designers will be unable to make changes to these files. The drawings are updated when necessary. All proposed changes should be discussed during staff meetings.

#### **8.1.3.2 MDT Detailed Drawings**

The MDT Detailed Drawings provide road and traffic details for various design elements that are consistent from project to project (e.g., guardrail, sign posts, fencing, drainage details). They provide information on how to lay out or construct the various design elements.

It should be noted that the first three numbers of the detailed drawing number are coordinated with the Standard Specifications. For example, Detailed Drawing #606-05 "Metal Guardrail" is referenced to Section 606 "Guardrail, Median Barrier Rail and Guide Post" in the Standard Specifications.

Hard copies of the MDT Detailed Drawings can be obtained from the Contract Plans Section. These drawings are also provided on the Department's CADD system. The drawings are updated by the Contract Plans Section on an as-needed basis. All proposed changes to the MDT Detailed Drawings must be forwarded to the Construction Bureau for evaluation and action.

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## 8.2 SPECIAL PROVISION PREPARATION

Special Provisions are required whenever a project contains work, material, sequence of operations, or any other requirements that are necessary for the completion of the project but are not “described completely” in the construction plans, Standard Specifications, Supplemental Specifications or the MDT Detailed Drawings. “Described completely” should be interpreted to mean that the prospective bidder will be able to clearly understand the work to be accomplished, type of materials or equipment required, construction methods or details to be used, how the item of work will be measured and the basis of payment. The following sections provide guidelines for preparing Special Provisions.

### 8.2.1 Preparation Steps

Do not prepare Special Provisions using the “cut-and-paste” method. Instead, the designer should use the following steps when preparing a Special Provision:

1. Define Need. Review existing specifications, standard drawings or construction plans to ensure that there is a need for the Special Provision. If the topic is not adequately covered in one of the other contract documents, only then should a Special Provision be prepared.
2. Research. Research the topic so that complete and detailed information is available before writing the Special Provision. This may require contacting manufacturers, contractors or suppliers for the latest information. Local conditions and problems should also be fully investigated.
3. Format. Prepare Special Provisions in the same manner as the Standard Specifications.

Section 8.2.2 presents the format that should be used.

4. Type. Analyze the type of construction to be covered in the Special Provision to determine the type of Special Provision to be used. There are two basic types of Special Provision presentations — performance or end-result presentation, and material or method presentation. The preferred type is the performance presentation which describes the end result of construction. The types of procedures and materials to achieve the end result are at the contractor's discretion. The material or method presentation describes the procedure or materials that should be used to construct the element. The method presentation should only be used with the Crew Chief's approval.

Do not mix the presentation types within a Special Provision. However, the assembly of Special Provisions may contain both types of presentations.

5. Develop Outline. The outline should cover the basic requirements of the work to be completed or the materials to be used. It should define the essential physical characteristics of the material or work (e.g., dimensional limitations, time, strength, weight, size, shape, configuration). Organize all relevant factors under each appropriate heading.
6. Writing the Special Provision. Once the outline has been developed and all research has been completed, the first draft can then be prepared. The designer may want to review existing Special Provisions for guidance. The following presents several grammatical recommendations for preparing Special Provisions:

- a. **Wording.** Write the Special Provision in the active voice (sentence begins with a verb) and the imperative mood (sentence expresses a command).

Active Voice: "Apply rubbed finish to exposed surface."

Passive Voice: "Rubbed finish shall be applied to exposed surface."

- b. **Sentences.** Prepare the Special Provision using simple language and words. Keep words and sentences short (20 words or less), unless complexity is unavoidable.
- c. **Paragraphs.** Limit paragraphs to 3-4 sentences.
- d. **Terminology.** Use words consistent with their exact meaning. Use the same word throughout; do not use synonyms. Avoid any words which have a dual meaning. Section 8.2.4 presents the recommended terminology that should be used. Omit extraneous words and phrases.
- e. **Pronouns.** Avoid the use of pronouns, even if this results in frequent repetition of nouns.
- f. **Punctuation.** Carefully consider the punctuation using the minimum number of punctuation marks consistent with the precise meaning of the language. Make certain that there can be no doubt on the meaning of any sentence.
- g. **Parentheses.** Avoid the use of parentheses. Instead, use commas or rewrite the sentence.
- h. **Numbers.** It is usually unnecessary to write numbers both in words and figures

(e.g., "Use four (4) 25-in. bolts."). Write numbers less than or equal to ten as words. Write numbers higher than ten numerically. When writing dimensions, use numerals (e.g. 5 ft). Do not write 50 ft x 100 ft, but 50 ft by 100 ft. Times and dates should be written numerically. Write fractions as decimals. Decimals less than one should be preceded by the zero (e.g., 0.02 ft).

7. **Reviewing.** The designer should review the previously completed paragraphs as succeeding ones take shape. Where necessary, redraft preceding paragraphs to reflect later thoughts.
8. **Presentation.** Special Provisions should be presented as follows:
- a. Type Special Provisions that are specific to a project in Word. Store these files on the S:\ drive in the "Project" folder under the correct district.
- b. Standard Special Provisions that are modified should be typed in the Word format and stored in a long-term retention file with the provisions from Item 8a. Remove the date from the title to indicate the Standard Special has been modified.
- c. Identify Standard Special Provisions that are used without modification by their title, date, and number.

### 8.2.2 **Format**

Prepare Special Provisions in the same format as the Standard Specifications. The sections of the Special Provision that should be addressed include:

1. Description. Describe the work to be performed, with references to specifications, plans or other Special Provisions that further define the work. Where necessary or desirable for clarity, describe the relationship of this work item to other work items or other phases of construction.
2. Materials and/or Equipment. Designate the materials and/or equipment to be used in the work item and establish its requirements. Delineate complete specifications of the properties of each material and the method of tests. References may be made to AASHTO, ASTM or other recognized specifications.
3. Construction Details. Describe the sequence of construction operations or the desired end product. Do not mix the two types of presentations described in Section 8.2.1. Where practical, use the performance presentation. This will permit the contractor to use improved equipment and new and advanced ideas in construction methods. Only use the method presentation for the sequence of construction operations if it is critical to achieving the desired result. Specify quality control and quality assurance requirements, and specify who is responsible for testing.
4. Method of Measurement. Describe the components of the completed work item that will be measured for payment, the units of measurement and whether measured in original position, in transporting vehicles or in the completed work. Designate any modifying factors and other requirements needed to establish a definite, measured unit (e.g., disturbed or undisturbed, temperature, waste, etc.).
5. Basis of Payment. Describe the units for which payment will be made, and define the scope of the work covered by such payment.

The pay item name must match the bid item name.

### **8.2.3 Guidelines**

In addition to Sections 8.2.1 and 8.2.2, the following presents several guidelines the designer should consider when developing Special Provisions:

1. Completeness. When developing the Special Provision, ensure that the essentials have been included and that each requirement is definitive and complete. The Special Provision should not be vague.
2. Clarity. To ensure the Special Provision is clearly presented, the designer should review the following:
  - a. Clearly delineate the method of measurement and payment.
  - b. Make a clear, concise analysis of the job requirements for general conditions, types of construction and quality of workmanship. Do not leave the bidder in doubt on what he, as the contractor, will be required to do.
  - c. Give directions, never suggestions.
  - d. Never assume the engineer or contractor “knows” what is meant.
  - e. Minimize phrases such as “as approved by the engineer,” “at the discretion of the engineer,” or “as directed by the engineer” in place of definite workmanship requirements. Such phrases may lead to confusion or misunderstanding. The contractor may not know what the engineer is thinking.

- f. Only use the word “will” for actions to be performed by the Department.
  - g. Avoid conflicting or ambiguous requirements. Every specification should have only one meaning.
  - h. Never conceal difficulties or hazards from the contractor.
3. Conciseness. Write each Special Provision as concisely as practical. When reviewing the Special Provision, the designer should consider the following suggestions:
- a. Avoid duplications between the Special Provision and any related contract documents.
  - b. Do not give reasons for a specification requirement.
  - c. Do not provide additional information which is unnecessary for the preparation of bids and the accomplishment of the work.
  - d. Once stated, do not repeat any instruction, requirement, direction or information given elsewhere in the contract documents.
  - e. Do not include mandatory provisions that are required in general by the contract.
  - f. Minimize the use of cross references.
  - g. Write the specification in the positive form.
4. Correctness. To ensure that the Special Provision is written correctly, the designer should review the following:
- a. Where practical, independently cross-check every factual statement.
  - b. Do not include items that cannot be required or enforced.
  - c. Ensure that the specification does not punish the contractor or supplier.
  - d. Ensure that the specification does not unintentionally exclude an acceptable product, construction method or any equipment.
  - e. Ensure that the provision does not change the basic design of the item.
  - f. Do not specify impossibilities. The practical limits of workmen and materials must be known and recognized.
  - g. Specify standard sizes and patterns wherever practical.
  - h. Avoid personal whims and pet requirements.
  - i. Ensure that the contractor will not be held responsible for the possible inaccuracy of information furnished by the Department.
  - j. Ensure that sufficient attention has been provided to assessing the durability or reliability of the material or procedure discussed. The use of permanent and recognized standards should be quoted to ensure that the specified performance or characteristics are achieved. If not, completely and accurately define the testing criteria.
  - k. Make a careful, critical examination of manufacturers' or trade associations' recommendations, and require

supporting evidence before adopting them.

- l. Keep requirements stringent. A strong requirement can be relaxed more economically, when the need arises. Weak specifications cannot be strengthened without increasing cost and generating claims.
- m. Ensure that the provision gives directions that are consistent with the standard practice currently used by the Department.
- n. Ensure provision is consistent with plans and quantities.

6. At the contractor's expense. Do not use the phrase “at the contractor's expense”; instead use, “at no cost to the Department” or “absorbed in the cost of other contract items.”
7. Balance, remainder. Use the term “balance” when referring to money. Use “remainder” to describe something or material left over.
8. Coarse, course. Use “coarse” to describe textures and “course” for layers.
9. Conform. Use the word “conform” to refer to dimensions, sizes and fits that must be strictly adhered to (e.g., “cut bolt threads conforming to ASA Standards, Class 2 fit, coarse thread series”). Where a better product is acceptable, use the phrase “meeting the requirements of...”.

#### 8.2.4 Terminology

1. Abbreviations. Generally, avoid abbreviations. However, they may be used if they are defined and the definitions are consistent with the accepted meanings.
2. Amount, quantity. Use “amount” when writing about money only. When writing about measures of volume, such as yd<sup>3</sup>, gallons, etc., use “quantity.”
3. And/or. Avoid using “and/or”; instead, use “and” alone, or “or” alone, or “or ... or both.” For example, “Unless otherwise specified by the plans or Special Provisions or both, ...”
4. Any, all. The word “any” implies a choice and may cause confusion. Use the term “all” in place of “any.” For example, “Make good all defects.”
5. As per. Do not use “as per”; instead, use “as stated,” “as shown,” “conforming to,” or other similar phrases.
10. Contractor. Use the word “contractor” in place of the word “bidder” when writing Special Provisions for construction. Only use “bidder” for proposals.
11. Or equivalent. Use this phrase for only minor parts. The contractor may not know what is truly equivalent before awarded the contract. It is better to clearly specify those things that will be accepted as “equivalent.”
12. Proposal. Do not use the word “proposal” when the word “contract” is intended. Only use the term “proposal” to describe requirements during the bidding process.
13. Resisting, resistant. Do not use “corrosion-resisting,” but instead use, “corrosion-resistant.”
14. Said. Do not use “said pipe,” “said aggregates” but instead, use “this pipe,” “these aggregates.”

15. Same. Do not use “same” to replace a pronoun like “it” or “them” standing alone, such as “connected to same,” “specified for same,” “same will be given consideration,” “conforming to requirements for same.” Rewrite the sentence to clearly describe what is meant.
16. Shall. Avoid using the word “shall.” The Department has adopted “active voice” specifications. Rewrite the sentence using the active voice.
17. Such. Do not end a sentence with the word “such.” “Such” usually means “of this or that kind,” or similar to something stated. Instead, state that which is actually meant, or name the work to be completed or rephrase the sentence.
18. Symbols. Do not use the following symbols when writing Special Provisions:
- | <u>Symbol</u> | <u>Write Instead</u>     |
|---------------|--------------------------|
| /             | per, or “a”              |
| X°            | °F or degree Faronheight |
| %             | percent                  |
| +             | plus                     |
| -             | minus                    |
| x             | by                       |
19. The. Do not eliminate “the” for brevity.
20. Thoroughly. Avoid using the adverb “thoroughly,” as in thoroughly wet, thoroughly dry, thoroughly clean, etc., as it is unenforceable. Preferably, state the value of the intended requirements in percent, dimensions, number of passes, etc.
21. Will. Only use the word “will” for actions to be performed by the Department.



## Chapter Nine

# RECORDS AND FILES

### 9.1 PROJECT FILES

#### 9.1.1 General

The project files provide information on the project and a history of the project's development. Separate files are maintained for each project.

Project files are developed for the following categories:

1. Design. This portion of the file is maintained by the bridge design unit that has responsibility for the design of the project. Typically, it is the responsibility of the Bridge Area Engineer of the district that the project is located in. On State-wide or multi-district projects, the project responsibilities are determined early in the project development process. The project design file is typically comprised of the following parts:
  - a. Design Computations. Design computations are maintained for permanent reference during and after construction. They provide a permanent record of design analysis methods, materials used, loadings and structure dimensions. Section 9.1.2 further discusses what should be included with the design computations.
  - b. Quantities. Estimated quantities are retained until construction is completed. They are available to check the estimated quantities against the actual pay quantities. Keep the quantity calculations separate from the design calculations. Upon completion of plans

checking, file the quantities folder in the Administrative Assistant's area. Upon completion of construction of the project, the quantities folders are discarded.

- c. Survey. Survey data should be retained and filed with the design file.

2. Correspondence. The correspondence portion of the project file provides a single-source location for administrative information on the project and a history of the project's development. The following correspondence is typically located in the project correspondence file:

- a. Agreements. Include copies of any project agreements (e.g., programming documents, agreements with local governments, railroads, utilities, consultants).
- b. FHWA Correspondence. Include all correspondence sent or received from FHWA.
- c. Internal Department Memoranda. The correspondence file should contain the Preliminary Field Review Report and the Scope of Work Report regardless of which Unit or Section is managing the project. Include a green stamp copy of all correspondence prepared in the Bureau for the project. In addition, the correspondence file should also contain a copy of the Hydraulics Report, the Boring Logs, the Foundation Report and any other applicable reports.

- d. Other. Other miscellaneous documents may include programming information, any special instructions or concerns, problems which may have arose during design and any other information related to the project administration.

Project correspondence files are located in the Administrative Assistant's work area. They are separated into two broad categories and filed under the project number. One category is for projects that are under development (i.e., P.E. or Preliminary Engineering Phase) and the other is for projects that are under construction. The Administrative Assistant transfers the file from the "PE" category to the "Under Construction" category when a project is awarded to contract.

Specifications. When nonconventional methods or formulas are used in the design, list the sources of the methods or formula. When different considerations for economic purposes have been used, include all quantities and stress calculations substantiating these considerations.

When computations are made by a computer, identify the program used and include the computer input and output values with an explanation of the terms, assumptions and computations used. Provide a sketch with an explanation of all abbreviations and symbols used with the input and output sheets of the program.

### **9.1.2 Design Computations**

Copies of the design computations should be retained in the design file so that anyone can reconstruct the original design.

Arrange the design computations so that they can be easily followed by others. The title sheet of the computations should include the project number, project name, control number, station of structure(s), initials of those who prepared the computations and the date of preparation. Each sheet of the design computations should be thoroughly checked and initialed by the designer and the design checker. Also, include a table of contents.

In general, the design computations consist of geometric computations, quantity calculations, structural analyses and any necessary sketches. Each phase of computations should include a table showing a summary of the results. For example, structural analysis computations should indicate the actual and allowable stresses for the various loading groups. Reference the applicable equations and conditions to the appropriate sections of the AASHTO

## **9.2 MISCELLANEOUS FILES**

### **9.2.1 Special Provisions File**

“Standard” special provisions are special provisions which are commonly used on many projects. The Bridge Bureau has compiled a library of standard special provisions for bridge items. This library is routinely updated and sent to the design crews. For additional guidance on special provisions, see Chapter Eight.

### **9.2.2 Bridge Inspection File**

This file includes copies of the inspection reports for all bridges located on public roads and streets in the State and is maintained by the Bridge Management Section. The inspection reports are filed according to whether the structure is an on-system or off-system bridge. On-system bridges are filed according to the route and reference point. Off-system bridges are filed according to the county and the bridge ID number. Bridge inspection files will typically include:

1. the last five bridge inspection reports,
2. the Structure Inventory and Appraisal (SI&A) sheet,
3. photographs,
4. correspondence on bridge maintenance and repair, and
5. rating calculations.

### **9.2.3 Shop Drawings**

The Bridge Management Section maintains a file for all shop drawings used on structure projects. These drawings are filed according to the project number. The old shop drawings are

an invaluable resource when existing structure is repaired, modified or rehabilitated. Fabrication related correspondence is located in the shop drawings file. Some of the shop drawings that are retained include:

1. prestressed concrete beams,
2. steel girders,
3. guard angles,
4. bridge railings,
5. bridge bearings,
6. pier nose angles or ice plates,
7. deck expansion joints, and
8. welding procedures.

### **9.2.4 As-Built Plans**

As-built plans are kept in the Plans File Room and filed according to their drawing number. The as-built plans are used to determine what was actually constructed. They are most important for structure rehabilitation projects. During construction, the project manager will mark up one set of plans to indicate what changes were necessary for construction and how construction problems were resolved. Once the construction is complete, the District As-Built technician will create and complete Bridge As-Built plans using the strike out and edit procedure listed below. The marked up plans and memorandum are transmitted to the Construction Bureau. The Construction Bureau will then forward the plans to the appropriate design crew. The design crew will conduct the following:

1. Retrieve the appropriate CADD files from the AB directory on DMS.
2. After reviewing the corrections have mylar copies made of all sheets that have as-built changes. If additional corrections need to be made, do the following:

- a. Notify the district As-Built technician's supervisor of the error and have them resubmit corrections.
  - b. If the district is unable to make the corrections, do not delete the elements or text. Rather strike out the old element or text and place a new as-built element or text next to the original.
  - c. Place the as-built elements and text on the As-Built Micro Station level and make them a different color, weight and font from the originals. For details not used, simply strike out the entire detail.
  - d. A complete procedure on how to make corrections can be found on the MDT ftp site\documentation\As-BUILTs\
3. Replace and discard the previously filed mylar copies with the new ones in the file room.
  4. Restore the corrected CADD files to the AB directory on DMS.

### **9.2.5 Engineer's Estimate**

The Contract Plans Section is responsible for preparing the official Engineer's Estimate. However, the Bridge Bureau is responsible for preparing the bridge related portion of the Engineer's Estimate for transmittal to the Contract Plans Section. The Bridge Engineer maintains a file on all project estimates presently in the letting process. After the award, the file is typically purged.

## 9.3 MAINTENANCE OF FILES

### 9.3.1 General

The various types of files have different “custodians”:

1. Design Files. The Bridge Area Engineers are responsible for the design files. These are maintained in the crew area until the project has been constructed and then are “cleaned out” of material that is duplicated in the correspondence file, organized and filed downstairs with the survey. These files are retained until the structure is replaced.
2. Correspondence. The Administrative Assistant is responsible for maintaining the project correspondence file. When the Bridge Bureau is notified that a project has been completed, the correspondence file is transferred to Records Management. Correspondence files prior to circa 1970 are on microfilm. Paper copies of these older records do not exist.
3. Special Provision File. The Bridge Bureau standard special provisions consist of a set of files maintained by the Bureau on a server. They are accessible through the Bridge Bureau’s web page on both the Intranet and Internet.
4. Bridge Inspection File. The bridge inspection files are maintained by the Bridge Management Section.
5. Shop Drawings Files. The shop drawings files are maintained by the shop drawings reviewer. In general, shop drawings files are maintained in the reviewer’s area until a project is constructed, then they are filed in the Records Management area by the reviewer.

### 9.3.2 Structure Removal

When a bridge is replaced or removed, the following procedures will be used to update files:

1. Files will be maintained until construction is complete. Construction sends out an email when construction projects have been completed. Retain information for bridges that have been relocated.
2. Remove drawings from the file room. Check to see that drawings are in the microfilm record.
3. Note the bridge has been replaced or removed on the microfilmed records in the Bridge Bureau. Microfilm records will be retained for future information.
4. Request design, correspondence file, shop drawings, and construction diary from records management for disposal.
5. Note the bridge has been replaced or removed in the card file located in the bridge file room.
6. Drawings and files are reviewed by the Bridge Area Engineer to verify that correct records have been identified.
7. Drawings are given to the Department’s Historian; files are discarded.
8. Provide the Bridge Management Section the structure number of the bridge replaced or removed.

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